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A MONOGRAPH

OF THE

BRITISH DESMIDIACEÆ

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ADDITIONAL BIBLIOGRAPHY.

(See Vol. I, pp. xvii–xxxvi.)

West & G. S. West, *Freshw. Alg. Orkneys and Shetlands.*—W. West and G. S. West, Freshwater Algæ from the Orkneys and Shetlands. Trans. Botan. Soc. Edinburgh, XXIII, Oct. 1905.

West & G. S. West, *Further Contrib. Freshw. Plankton Scott. Lochs.*—W. West and G. S. West, A Further Contribution to the Freshwater Plankton of the Scottish Lochs. Trans. Roy. Soc. Edinburgh, XLI, 1905.

BRITISH DESMIDIACEÆ.

Genus 13. **EUASTRUM** Ehrenb., 1832.

Ehrenb. Entwick. Lebends. d. Infus. 1832, p. 82 (in part).
Ehrenb. Infus. 1838, p. 160.
Ralfs in Ann. Mag. Nat. Hist. 1844, p. 187.
Ralfs, Brit. Desm. 1848, p. 78.
De Bary, Conj. 1858, p. 50, 70–71.
Arch. in Pritch. Infus. 1861, pp. 720, 728.
Rabenh. Flor. Europ. Algar. III, 1868, p. 179.
Wolle, Desm. U.S. 1884, p. 97.
Cooke, Brit. Desm. 1886, p. 63.
Hansg. Prodr. Algenfl. Böhm. 1888, p. 203.
De Toni, Syll. Alg. 1889, p. 1065.
G. S. West, Treatise Brit. Freshw. Alg. 1904, p. 164.

Cells of variable size, longer than broad, *compressed*, deeply constricted in the middle, sinus generally linear (rarely open); semicells commonly truncate-pyramidate, *apex with a median incision of variable depth*, sometimes scarcely evident or absent, lateral margins entire, sinuate, or variously lobed, at or near the centre of the semicells *with one or more somewhat hemispherical protuberances* (or *tumours*) variously disposed; vertical view more or less elliptical, with one or more protuberances on each side; one chloroplast in each semicell, often irregularly lobed and ridged, with a single central pyrenoid in the small species, and a number of scattered ones in the large species.

Zygospores globose, ellipsoid, or oblong-ellipsoid, ornamented with numerous conical papillæ, or with simple (or furcate) spines.

The genus *Euastrum* is separated from the preceding genera of the Cosmarieæ by the relatively short, compressed cells. It resembles *Tetmemorus* in the presence of the apical notch, but differs in its short, compressed cells, with sinuate or lobed margins and central protuberances (or tumours).

Euastrum includes a great variety of species, some of which are transitional forms connecting it with other genera, such as *Cosmarium* and *Micrasterias*. *E. verrucosum* is the only British species connecting it with *Micrasterias*, but quite a number of British species connect the genus with *Cosmarium*; such (for example) are,—*E. occidentale*, *E. montanum*, *E. Cornubiense*, and *E. crispulum*.

Most of the species are lobed, some more than others, and there is always an odd number of lobes. The unpaired lobe at the apex of the semicell is always termed the *polar lobe*; the others are known as *lateral lobes*.

The name "*Helierella*" (Bory, 'Dictionnaire classique d'Histoire naturelle,' 1826, vol. viii, p. 98) which was revived by O. Kuntze ('Revis. gen. plant.' 1891, p. 897, etc.) is absolutely useless as a generic name. It is impossible to establish a genus on the remarks made by Bory, and Kuntze's genus *Helierella* includes two well-defined and well-known genera of Desmids.

There are 46 British species, less than half of which can be considered as common. They can be conveniently arranged, with due consideration of their relationships, as follows:—

Section A. Polar lobe with a distinct median notch, often deep and linear.

a. Cells generally large (length 50—205μ), polar lobe short; cell-wall usually punctate or scrobiculate; external angles of polar lobe rounded.

* Lateral margins lobed or sinuate.

1. *E. ventricosum.*
2. *E. crassum.*
3. *E. humerosum.*
4. *E. pinnatum.*
5. *E. oblongum.*
6. *E. Didelta.*
7. *E. affine.*
8. *E. ampullaceum.*
9. *E. sinuosum.*
10. *E. Jenneri.*
11. *E. aboense.*
12. *E. inerme.*

** Lateral margins entire.

13. *E. cuneatum.*
14. *E. ansatum.*
15. *E. obesum.*
16. *E. pingue.*

β. Cells of medium size (length 26—135 μ), polar lobe distinctly elongate; cell-wall smooth or scrobiculate; external angles of polar lobe rounded.

17. *E. insigne.*
18. *E. intermedium.*
19. *E. Webbianum.*

γ. Cells generally small (length 10—79 μ); cell-wall smooth, granulate, or spinous; external angles of polar lobe usually furnished with a spine.

* Lateral margins crenate, lobed, or sinuate.

† Margins crenate.

20. *E. Sendtnerianum.*

†† Margins lobed or sinuate.

21. *E. rostratum.*
22. *E. Turnerii.*
23. *E. spinosum.*
24. *E. bidentatum.*
25. *E. pictum.*
26. *E. divaricatum.*
27. *E. dubium.*
28. *E. erosum.*

** Lateral margins usually without lobes.

29. *E. pulchellum.*
30. *E. elegans.*
31. *E. binale.*
32. *E. denticulatum.*
33. *E. minutissimum.*
34. *E. incavatum.*
35. *E. montanum.*

Section B. Polar lobe entire, generally somewhat retuse in the middle.

α. Cells large, 48—114 μ in length.

* Margin distinctly lobed.

† Cell-wall smooth.

36. *E. pectinatum.*

†† Cell-wall granulate.

37. *E. gemmatum.*
38. *E. verrucosum.*

** Margin not lobed; cell-wall granulate.

39. *E. occidentale.*

β. Cells small, 17·5—48 μ in length.

* Semicells distinctly three-lobed.

40. *E. insulare.*
41. *E. crassangulatum.*
42. *E. Cornubiense.*

** Semicells not distinctly three-lobed.

43. *E. crassicolle.*
44. *E. crispulum.*
45. *E. sublobatum.*
46. *E. validum.*

1. **Euastrum ventricosum** Lund.

(Pl. XXXIII, figs. 1–3.)

? *Euastrum crassum* (Bréb.) Kütz. var. β Ralfs, Brit. Desm. 1848, t. 11, f. 3 *e, f.*

Euastrum ventricosum Lund. Desm. Suec. 1871, p. 18, t. 2, f. 2; Wolle, Desm. U.S. 1884, p. 160; Cooke, Brit. Desm. 1886, p. 67, t. 33, f. 1; Wolle, Freshw. Alg. U.S. 1887, p. 38, t. 58, f. 1-3; De Toni, Syll. Alg. 1889, p. 1090; West, Alg. N. Wales, 1890, p. 287; Alg. W. Ireland, 1892, p. 137; Roy & Biss. Scott. Desm. 1893, p. 178; Nordst. Index Desm. 1896, p. 267; West & G. S. West, Alg. S. England, 1897, p. 483; Alg. N. Ireland, 1902, p. 28.

Helierella ventricosa Kuntze, Revis. gen. plant. 1891, p. 899.

Cells rather above the medium size, 1½ times longer than broad, deeply constricted, sinus narrowly linear; semicells in front view somewhat semi-elliptical, strongly dilated at the base, unequally three-lobed, the intervening incisions narrow; polar lobe smaller than lateral lobes, strongly convex, with a deep and narrow median incision, from vertical view oblong-elliptic with deeply emarginate poles; lateral lobes bilobulate, with a broad median hollow, upper lobule obtuse and from the side view entire, lower lobule subtriangular with basal angles somewhat rounded; semicells with three tumours across the base and two across the middle. Side view of semicell somewhat pyramidate, with a protuberance on each side below the middle; apex dilated, truncate, with rounded angles. Vertical view angular-elliptic, showing five undulations on each side. Cell-wall punctate.

Zygospore globose, furnished with large pointed teeth which are mostly curved (about twelve teeth visible around the margin).

Length 80–136 μ; breadth 52–80 μ; breadth of isthmus 18–28 μ; thickness 33–48 μ; diam. zygosp., with teeth, about 110 μ.

England.—Near Bowness, Westmoreland (*Bissett*). Hawkshead, Lancashire! Thursley Common, Surrey! Near Bovey Tracey, Devon (*Bennett*).

Wales.—Llyn Teyrn, Snowdon, bog above Capel Curig Lakes, Carnarvonshire! Dolgelly, Merioneth!

Scotland. — Sutherland! Inverness! Aberdeen!

Kincardine, Perth! Argyll, Arran (*Roy & Bissett*). Ross and Skye! General and often abundant in the Outer Hebrides!

Ireland. — Lough Macgrath and near Dungloe, Donegal! Near Foxford, Mayo! Ballynahinch, Kylemore, and Lakes near Recess, Galway! Carrantuohill and near Castletown, Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—Sweden. India (var.). United States.

This characteristic species is somewhat rare in the British Islands. In some parts of the west of Ireland, Skye, and in the Outer Hebrides, it occurs in large quantity along with *E. inerme* (Ralfs) Lund.

It is considerably smaller than *E. crassum*, of different proportions, and differs considerably in its lateral lobes, the upper lobules of which are entire. Wolle observed the zygospore from Florida, U.S.A.

2. **Euastrum crassum** (Bréb.) Kütz.

(Pl. XXXIII, figs. 4–6.)

Heterocarpella crassa Bréb. in Cheval. microscop. et usage, Paris, 1839, p. 272 (name).
Cosmarium crassum Bréb. in Menegh. Synops. Desm. 1840, p. 222.
Euastrum Pelta Ralfs in Ann. Mag. Nat. Hist., xiv, 1844, p. 190, t. 7, f. 1.
Euastrum crassum (Bréb) Kütz. Phycol. germ. 1845, p. 135; Ralfs, Brit. Desm. 1848, p. 81, t. 11, f. 3; Arch. in Pritch. Infus., 1861, p. 728; Rabenh. Flor. Europ. Algar. III, 1868, p. 181; Lund. Desm. Suec. 1871, p. 17, t. 1, f. 10; Kirchn. Alg. Schles. 1878, p. 157; Wolle, Desm. U.S., 1884, p. 97, t. 25, f. 1-3; Cooke, Brit. Desm. 1886, p. 65, t. 32, f. 1; Hansg. Prodr. Algenfl. Böhm. 1888, p. 205; De Toni, Syll. Alg. 1889, p. 1088; West, Alg. N. Wales 1890, p. 287, t. 6, f. 33; West, Alg. W. Ireland, 1892, p. 136; Roy & Biss. Scott. Desm. 1893, p. 176; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 60; Alg. N. Ireland, 1902, p. 27.
E. crassum var *appendiculatum* Bréb. Liste Desm. 1856, p. 122.
E. crassum b. *majus* Rabenh. Flor. Europ. Algar. III, 1868, p. 182.
E. crasso-humerosum Benn. in Ann. Bot. iv, 1889, p. 171; in Journ. Roy. Micr. Soc. 1890, p. 7, t. 1, f. 14 (figure bad!).
Helierella crassa Kuntze, Revis. gen. plant. 1891, p. 898.
Euastrum magnificum Wolle var. *crassoides* Wolle, in Hastings' 'Desm. New Hampsh.,' Amer. Month. Micr. Journ. 1892, p. 153, f. 1. (*Vide* West. & G. S. West in Journ. Bot. 1895, p. 67.)

Cells large, almost twice as long as broad, elliptic-oblong, deeply constricted, sinus narrowly linear; semicells in front view unequally three-lobed, inter-

vening incisions narrow, closed or slightly open; polar lobe smaller than the lateral lobes, convex and broadly cuneate, with a deep and narrow median incision, from vertical view oblong-elliptic with deeply emarginate poles; lateral lobes very broad, sides broadly hollowed (sometimes with a rounded lateral projection), angles rounded; semicells with three prominent protuberances across the base and two very slight tumours across the middle. Side view of semicell subpyramidate, with subrectangular basal angles and a rounded-truncate apex, the upper lateral lobule emarginate and the lower one entire. Vertical view oblong-elliptic, with a slight protuberance at each pole and one in the centre of the convex sides. Cell-wall punctate, angles of lobes strongly thickened.

Zygospore unknown.

Length 163–205 μ; breadth 79–106 μ; breadth of isthmus 24–30 μ; thickness 56–75 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W. and N. Yorks! Lancashire! Wilts! Surrey! Sussex! (*Ralfs*). Kent! (*Ralfs*). Hants! (*Ralfs*). Devon! (*Bennett*). Cornwall.

Wales.—General in Carnarvonshire (Glyder Fach at 2,200 ft.)! Dolgelly, Merioneth!

Scotland.—General! (*Roy & Bissett*).

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Down!

Geogr. Distribution. — France. Germany. Galicia in Austria. Italy. Norway. Sweden. Denmark. Finland. Poland. Faeroes. India. United States.

E. crassum is a large and handsome species which occurs abundantly in many parts of the British Isles, and it is rather remarkable that up to the present time its zygospores have escaped observation.

It is a somewhat variable species with regard to the incisions between the lobes and the form of the lateral lobes. The interlobular incisions may be narrow and closed, or they may be considerably open, and the lateral lobes frequently possess a median rounded protuberance. This is a variation which has received a name from several authors ("var. *appendicu-*

latum Bréb." ; "var. *majus* Rabenh."), but which is not a true variety. Frequently one semicell is typical and the other in possession of this lateral protuberance. Such is the example we have figured on Pl. XXXIII, fig. 4. Consult also, West, 'Alg. N. Wales,' 1890, p. 287, t. 6, fig. 33.

The Desmid to which Bennett gave the name "*E. crasso-humerosum* n. var." is a very badly drawn specimen of *E. crassum*, in which the interlobular incisions were somewhat open. Bennett's idea that it was a hybrid was a mere supposition; he did not even examine the nature of its protuberances or obtain its other views.

Var. **scrobiculatum** Lund. (Pl. XXXIII, figs. 7, 8.)

Euastrum crassum var. *scrobiculatum* Lund. Desm. Suec. 1871, p. 18, t. 2, f. 1; Nordst. Norges Desm. 1873, p. 8; De Toni, Syll. Alg. 1889, p. 1088; West, Alg. W. Ireland, 1892, p. 136; West & G. S. West, Some N. Amer. Desm. 1896, p. 242, c. fig. xylogr.; Alg. S. England, 1897, p. 483; Alg. N. Ireland, 1902, p. 27.

Cells usually smaller than in the type; lateral margins of semicells not so hollowed, often straight; in the centre of the semicells (in the neighbourhood of the two small tumours) with 1–6 large scrobiculations, variously disposed; side view of semicells with more ventricose lateral margins, considerably attenuated towards the apex; vertical view rather more rectangular-oblong than in the type.

Length 134–169 μ; breadth 65–88 μ; breadth of isthmus 18–26 μ; thickness 51–65 μ.

England.—New Forest, Hants!

Scotland. — Skye, Inverness! Harris, Lewis, N. Uist, and Benbecula, Outer Hebrides!

Wales.—Moel Siabod, bog above Capel Curig, bog between Glyder Fach and Llugwy, Carnarvonshire!

Ireland.—Near Gweedore, near Loughs Glentornan and Magrath, Donegal! Cromagloun, Kerry!

Geogr. Distribution.—Germany. Norway. Sweden. Denmark. Poland. Faeroes. United States. West Indies.

This is a very characteristic variety of rare occurrence. The scrobiculations in the centre of the semicells, which are the largest marks of that type in any Desmid, vary much in

number and in disposition, the commonest arrangements being two (one vertically over the other), and four disposed in the form of a cross. This variability was first pointed out by Nordstedt. The side and vertical views of this variety also differ to a certain extent from those of the type.

Var. **Taturnii** *var. nov.* (Pl. LV, fig. 4.)

Cells with a widely-open, acuminate sinus, basal angles of semicells subuncinate-mamillate; polar lobe anvil-shaped with a convex apex, incisions on each side below the polar lobe widely excavated towards their inner extremities; cell-wall strongly punctate, with a single large scrobiculation in the centre of each semicell. Side and vertical views as in the type.

Length 165 μ; breadth 110 μ; breadth of isthmus 37 μ.

England.—Near Salisbury, Wilts! (*E. J. Taturn*).

This variety occurred amongst numerous specimens of the type in a collection from a Sphagnum-bog.

The form of *E. crassum* described by Wood as "*E. ornatum*" (*vide* Wood in 'Proc. Acad. Nat. Sci. Philad.,' 1870, p. 17; 'Freshw. Alg. N. Amer.,' 1873, p. 137, t. 21, f. 12), and subsequently placed as "*E. crassum* var. *ornatum*" by Hansgirg (1888), may possibly be the same as this variety, but neither the description nor the figure given by Wood is sufficiently accurate to determine the identity of the form in question.

Note.—*E. crassum* var. *cornubiense* Benn. Alg. N. Cornwall, 1887, p. 16, t. 4, f. 19; Cooke, Brit. Desm., 1887, t. 65, f. 4 (from Bennett); De Toni, Syll. Alg., 1889, p. 1088. This is a form of *E. crassum* with open interlobular incisions and with the lateral protuberances on the margins of the lateral lobes, which is most incorrectly described and still more badly figured. "Protuberances" such as those described and figured by Bennett do not occur on any known *Euastrum*. Moreover, his dimensions are vastly different from the proportions of his figure.

3. **Euastrum humerosum** Ralfs.

(Pl. XXXIV, figs. 1, 2.)

Euastrum humerosum Ralfs, Brit. Desm. 1848, p. 82, t. 13, f. 2; Arch. in Pritch. Infus. 1861, p. 729; Rabenh. Flor. Europ. Algar. III, 1868,

p. 182; Wolle, Desm. U. S. 1884, p. 99, t. 28, f. 12-13; Cooke, Brit. Desm. 1886, p. 66, t. 32, f. 3; De Toni, Syll. Alg. 1889, p. 1090; West, Alg. W. Ireland, 1892, p. 137; Alg. Eng. Lake Distr. 1892, p. 722; Roy. & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 141; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 61.

E. humerosum a. *genuinum* Racib. Nonn. Desm. Polon. 1885, p. 93.

E. pinnatum Ralfs b. *intermedium* Racib l.c. p. 93, t. 13, f. 4.

Helierella humerosa Kuntze, Revis. gen. plant. 1891, p. 898.

Cells of moderate size, rather less than twice as long as broad, deeply constricted, sinus narrowly linear and dilated at the apex; semicells five-lobed, incisions between the lobes widely open, upper incisions deeper and less widely open than lower incisions; polar lobe dilated, almost anvil-shaped with rounded angles, apex convex, straight, or even slightly retuse, with a fairly deep and narrow median incision; upper lateral lobes mamillate or narrowly mamillate, directed upwards and outwards; lower lateral lobes subquadrate, with retuse margins and rounded angles; semicells with three prominent protuberances across the base and two smaller ones across the middle. Vertical view elliptic, with three prominent protuberances on each side. Cell-wall punctate.

Zygospore unknown.

Length 110–123 μ; breadth 65–75 μ; breadth of isthmus 15·5–22 μ; thickness 40 μ.

England.—Blea Tarn, Westmoreland! Pilmoor, N. Yorks! New Forest, Hants (*Ralfs*). Near Bovey Tracey, Devon (*Bennett*). Halgavor Moor, Cornwall!

Wales.—Llyn Padarn!, Llyn-y-cwm-ffynon!, and near Bettws-y-coed (*Roy*), Carnarvonshire. Dolgelly, Merioneth (*Ralfs*).

Scotland.—Ross! Inverness, Aberdeen! Kincardine, Forfar, Perth, Argyll, Arran (*Roy & Bissett*).

Ireland.—Lough Guitane and Carrantuohill, Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Austria and Galicia. Norway. Sweden. Finland. Poland. Faeroes. India. United States.

E. humerosum is the rarest of the larger British species of *Euastrum*. It is subject to considerable variation in the

depth of the interlobular incisions, the amount of projection of the upper lateral lobes, and in the shape of the polar lobe. We have given a figure of the form of this species most often observed in Scotland (Pl. XXXIV, fig. 1), and it will be seen to differ from the figures given by Ralfs in the convex apex of the polar lobe and in the less deep incisions beneath the polar lobe. All intermediate stages occur between this form and the one figured by Ralfs.

Archer (in 'Quart. Journ. Micr. Sci.,' 1875, p. 414) observed a zygospore formed by the conjugation of *E. humerosum* and *E. Didelta*. This is the only case of true hybridization ever recorded among the Desmidiaceæ, and it would have been most interesting to have witnessed the development of the zygospore.

Some specimens possess three large scrobiculations situated in the centre of the semicell between the tumours. This form has been named "forma *scrobiculata* Nordst."

4. **Euastrum pinnatum** Ralfs.

(Pl. XXXIV, figs. 3–6.)

Euastrum pinnatum Ralfs, Brit. Desm. 1848, p. 81, t. 13, f. 1; Arch. in Pritch. Infus. 1861, p. 728; Rabenh. Flor. Europ. Algar. III, 1868, p. 182; Lund. Desm. Suec. 1871, p. 19; Wolle, Desm. U.S. 1884, p. 98, t. 28, f. 14-16; Cooke, Brit. Desm. 1886, p. 66, t. 32, f. 2; De Toni, Syll. Alg. 1889, p. 1089; West, Alg. W. Ireland, 1892, p. 137; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 201; West & G. S. West, Alg. N. Ireland, 1902, p. 28.

E. pinnatum a. *typicum* Racib. Nonn. Desm. Polon. 1885, p. 93.

E. multilobatum Benn. Freshw. Alg. Eng. Lake Distr. 1886, p. 8, t. 1, f. 11 (figure bad).

Helierella pinnata Kuntze, Revis. gen. plant. 1891, p. 899.

Cells moderately large, about twice as long as broad, deeply constricted, sinus narrowly linear with the extremity dilated; semicells five-lobed, incisions between the lobes fairly deep and widely open; polar lobe projecting, anvil-shaped with rounded angles, apex straight, rarely retuse or convex, with a fairly deep and narrow median incision; upper lateral lobes broadly mamillate, with the upper margin horizontal (sometimes much broader, subquadrate, and subemarginate); lower lateral lobes subquadrate, and retuse with rounded angles; semicells with a large protuberance within each of the lower lateral lobes, and with three smaller ones at the base near the centre,

one just above the isthmus and two others immediately above it, forming a triangle with it ; upper half of semicell destitute of protuberances. Side view of semicell with the lower third subrectangular and upper third elongate-pyramidate, protuberances of lower part of semicell showing distinctly at the sides near the base; apices dilated, slightly retuse and with rounded angles ; upper lateral lobe widely emarginate. Vertical view elliptic, with four prominent protuberances at each side, and a fifth showing between and below the two central ones ; upper lateral lobes widely emarginate ; polar lobe oblong-rectangular, with retuse sides, emarginate poles, and rounded angles. Cell-wall coarsely punctate, angles and protuberances frequently scrobiculate (and with a slightly roughened surface).

Zygospore unknown.

Length 130–153 μ ; breadth 68–77 μ ; breadth of isthmus 20–24 μ ; thickness 46–50 μ.

England.—Angle Tarn, Cumberland ! Elter Water !, near Bowness (*Bissett*), Loughrigg (*Bennett*), Westmoreland. Hawkshead, Lancashire ! New Forest, Hants (*Bennett*).

Wales.—Capel Curig and Llyn-y-cwm-ffynon !, Pen-y-gwryd (*Roy*), Carnarvonshire. Dolgelly, Merioneth (*Ralfs*).

Scotland.—Sutherland ! Ross !, Aberdeen, Kincardine, Forfar, Perth, Argyll (*Roy & Bissett*). Lewis, Harris (often abundant), and N. Uist, Outer Hebrides !

Ireland.—Dungloe, Donegal ! Roundstone, Ballynahinch, Loughs Aunierin and Shindilla, Galway ! Near Castletown and Carrantuohill, Kerry ! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Galicia in Austria. Norway. Sweden. Faeroes. United States.

E. pinnatum is a very characteristic species, and in certain parts of the west of Scotland and Ireland it occurs in abundance. The figures given by Ralfs (*l.c.* t. 13, f. 1) are not good. Ralfs' fig. 1 *a* gives a correct idea of the outline of the average form, but figs. 1 *b*, *c*, and *d* are incorrectly drawn,

fig. 1 *c* of the side view being particularly erroneous. Ralfs did not grasp the disposition of the protuberances on *E. pinnatum*, causing Lundell ('Desm. Suec.' 1871, p. 19) to mention the typical form as a "forma." The upper half of the semicell (in fact, all that part of it above the inferior interlobular incisions) is quite destitute of any trace of protuberances on its surface. There is one large protuberance within each lower lateral lobe, and there are three others (not four as figured by Ralfs) in the centre of the basal part of the semicell. These three are smaller and disposed in the form of a triangle with one angle immediately above the isthmus. Lundell was thus quite right in his interpretation of the protuberances on his Swedish specimens.

The principal variation met with is in the upper lateral lobes. These lobes are *always* widely emarginate when seen in either the side or vertical views, but generally mamillate and entire when seen in front view. In some specimens, however, these lobes are very broad in front view (*vide* Pl. XXIV, fig. 6), and they may be rounded-quadrate with retuse margins. Every state is met with between the ordinary mamillate condition and the retuse condition, and the two extremes may be found on the same cell. These forms with the broad, retuse, upper lateral lobes greatly resemble *E. oblongum*, but can be at once distinguished in either the side or vertical view.

5. **Euastrum oblongum** (Grev.) Ralfs.

(Pl. XXXIV, figs. 7–9; Pl. XXXV, fig. 2.)

? ? *Euastrum Pecten* Ehrenb. Entwick. Lebends. d. Infus. 1832, p. 82 (Description insufficient for identification).

Echinella oblonga Grev. in Hook. Brit. Flor. 1833, II, p. 398.

Cosmarium sinuosum Corda, Almanach de Carlsbad, 1835, p. 121, t. 2, f. 21.

Micrasterias sinuata Bréb. et God. Alg. Falaise, 1835, p. 55, t. 7.

Heterocarpella sinuata Bréb. in Cheval. microscop. et usage, Paris, 1839, p. 272.

Cosmarium oblongum Bréb. in Menegh. Synops. Desm. 1840, p. 221.

Eutomia oblonga Harv. Man. Brit. Alg. 1841, p. 188.

Euastrum oblongum (Grev.) Ralfs in Ann. Mag. Nat. Hist. xiv, 1844, p. 189, t. 6, f. 4; Hass. Brit. Freshw. Alg. 1845, p. 380, t. 91, f. 1; Ralfs, Brit. Desm. 1848, p. 80, t. 12; Arch. in Pritch. Infus. 1861, p. 728, t. 3, f. 11; Rabenh. Flor. Europ. Algar. III, 1868, p. 181; Delp. Desm. subalp. 1873, p. 99, t. 6, f. 26-30; Kirchn. Alg. Schles. 1878, p. 157; Wolle, Desm. U.S. 1884, p. 98, t. 25, f. 5 (figure bad); Cooke, Brit. Desm. 1886, p. 64, t. 31, f. 2; Hansg. Prodr. Algenfl. Böhm. 1888, p. 204; De Toni, Syll. Alg. 1889, p. 1086; West, Alg. W. Ireland, 1892, p. 136; Alg. Eng. Lake District, 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 185; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 61; Alg. N. Ireland, 1902, p. 27; Scott. Freshw. Plankton, I, 1903, p. 525.

Euastrum oblongiforme Cramer in Hedwigia, 1863, p. 64, t. 12, f. 3.
Didymidium (*Euastrum*) *oblongum* Reinsch, Algenfl. Franken, 1867, p. 136.
E. oblongum b. *oblongiforme* (Cram.) Rabenh. Flor. Europ. Algar. III, 1868, p. 181; Racib. Nonn. Desm. Polon. 1885, p. 93; De Toni, Syll. Alg. 1889, p. 1087.
E. oblongum var. *trigibbum* Schaarschm. Magyar. Desm. 1882, p. 262, t. 1, f. 2.
E. oblongum formæ *genuinæ* (1. *typicum*; 2. *subcylindricum*; 3. *elongatum*) Racib. Nonn. Desm. Polon. 1885, p. 93.
Helierella Pecten Kuntze, Revis. gen. plant. 1891, p. 897.

Cells large, about twice as long as broad, in general outline oblong-elliptic, deeply constricted, sinus narrowly linear and slightly dilated at the apex; semicells five-lobed, incisions between the lobes fairly deep and generally slightly open (upper ones occasionally closed); polar lobe widely cuneate, with rounded angles, apex convex with a deep and narrow median incision; upper and lower lateral lobes similar, upper ones slightly smaller than lower ones, subquadrate with retuse margins and rounded angles; semicells with a protuberance within each of the lateral lobes, with one at the base immediately above the isthmus, and with two smaller ones in the centre (often with a large scrobiculation between them). Side view of semicell elongate-pyramidate, with rectangular basal angles and a dilated, convex apex; lateral lobes rotund-rhomboidal, with somewhat retuse margins, upper angle of upper lateral lobe rarely emarginate. Vertical view broadly elliptic, poles narrow and rounded, sides with four protuberances and a fifth one between and beneath the two central ones; polar lobe oblong elliptical, with convex sides, emarginate poles, and rounded angles. Cell-wall finely punctate.

Zygospore globose, closely covered with numerous mamillate projections.

Length 144–205 μ; breadth 74–107 μ; breadth of isthmus 20–31 μ; thickness 46–65 μ; diam. zygosp. without mamillate projections 92–123 μ; length of mamillæ 7·5–9 μ.

England.—Cumberland! Westmoreland!, (*Ralfs*). W., N. and E. Yorks. (zygospores from Pilmoor, N. Yorks)! Lancashire! Cheshire (*Ralfs*). Leicestershire

(*Roy*). Essex! Warwick (*Wills*). Surrey! (*Ralfs*). Sussex (*Ralfs*). Hants.! (*Ralfs*). Devon! Cornwall!

Wales.—Fairly general!

Scotland.—General! (*Roy & Bissett*). Zygospores from Powlair, Aberdeen (*Roy & Bissett*). Outer Hebrides! Orkneys! Shetlands!

Ireland. — Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Zygospore from Carrick Mountain, Wicklow (*Archer*). Down! Londonderry!

Geogr. Distribution.—France. Germany. Austria (var.) and Galicia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. Poland. N., Central, and S. Russia. Faeroes. Greenland. Japan. United States. Brazil.

This is a large and handsome Desmid which is generally distributed throughout the British Islands. The figures given by Ralfs are not very accurate except for the outline. That author failed to depict the two small, central protuberances in each semicell, and his vertical view is very erroneous. Between and slightly below these central protuberances a large scrobiculation is frequently present; this form has been named "forma *scrobiculata* Nordst."

There are no protuberances on the front surface of the polar lobe such as are indicated by Ralfs and other observers. This is seen at once from the vertical view. The protuberances figured by Ralfs and others on the polar lobes of many species of this genus are frequently due to the refraction caused by the vertical emargination of each side of the polar lobe.

Var. **cephalophorum** West. (Pl. XXXV, fig. 1.)

E. oblongum Wolle, Desm. U.S. 1884, t. 25, f. 6.
E. oblongum (Grev.) Ralfs var. *cephalophorum* West, New Brit. Freshw. Alg. 1894, p. 4; Roy & Biss. Scott. Desm. 1894, p. 255.

A variety with the lower interlobular incisions widely open, and the upper interlobular incisions narrowly linear; upper lateral lobes much smaller than the lower lateral lobes.

Length 155 μ; breadth 90 μ; breadth of isthmus 27 μ.

Scotland.—Near the Spittal of Glen Shee, Perth!

Var. **depauperatum** *var. nov.* (Pl. XXXIV, fig. 10.)

A variety with the interlobular incisions very shallow and widely open; polar lobe more rounded and lateral lobes very short.

Length 140 μ; breadth 63 μ; breadth of isthmus 17 μ.

Ireland.—Near Glenties, Donegal!

We mentioned the occurrence of this form in the 'Alg. of N. Ireland,' 1902, p. 27.

Note.—E. oblongum var. *integrum* Benn. Alg. N. Cornwall, 1887, p. 16, t. 4, f. 18; Cooke, Brit. Desm. 1887, t. 66, f. 1 (from Bennett); De Toni, Syll. Algar. 1889, p. 1088. Bennett's description of this form together with his bad figure make future identification of it impossible. The "protuberances" he mentions are such as are not found in any *Euastrum* of this group; neither is any form of *E. oblongum* known in which the polar lobe is entire. (Consult remarks under "*E. crassum* var. *cornubiense*," p. 8.)

6. **Euastrum Didelta** (Turp.) Ralfs.

(Pl. XXXV. figs. 3–7.)

? ? *Heterocarpella Didelta* Turp. Aperçu organograph. 1828, p. 315, t. 13, f. 16.

? ? *Cosmarium fenestratum* Corda, Almanach de Carlsbad, 1839, p. 243, t. 5, f. 29.

Cosmarium Didelta Menegh. Synops. Desm. 1840, p. 219; Kütz. Spec. Alg. 1849, p. 174.

Euastrum Didelta (Turp.) Ralfs in Ann. Mag. Nat. Hist. xiv, 1844, p. 190, t. 7, f. 2 *a* and *b* only; Hass. Brit. Freshw. Alg. 1845, p. 381, t. 90, f. 8; t. 91, f. 11; Ralfs, Brit. Desm. 1848, p. 84, t. 14, f. 1; Arch. in Pritch, Infus. 1861, p. 729, t. 1, f. 23–25; t. 3, f. 61; Rabenh. Flor. Europ. Algar. III, 1868, p. 184; Delp. Desm. subalp. 1873, p. 105, t. 6, f. 2; Kirchn. Alg. Schles. 1878, p. 157; Wolle, Desm. U.S. 1884, p. 99, t. 29. f. 9–10; Cooke, Brit. Desm. 1886, p. 69, t. 34, f. 1; Hansg. Prodr. Algenfl. Böhm. 1888, p. 205; De Toni, Syll. Alg. 1889, p. 1093; West, Alg. W. Ireland, 1892, p. 137; Alg. Eng. Lake Distr. 1892, p. 723; Roy & Biss. Scott. Desm. 1893, p. 176; Nordst. Index Desm. 1896, p. 106; West & G. S. West, Alg. S. England, 1897, p. 483; G. S. West, Variations Desm. 1899, p. 382, t. 8, f. 13–19; West & G. S. West, Alga-fl. Yorks. 1900, p. 61; Alg. N. Ireland, 1902, p. 28.

E. Didelta var. *sinuatum* Gay, Monogr. loc. Conj. 1884, p. 56, t. 1, f. 11.

E. Didelta a. *typicum* Racib. Nonn. Desm. Polon. 1885, p. 92.

E. Didelta b. *tatricum* Racib. l.c. t. 13, f. 3.

Helierella fenestrata Kuntze, Revis. gen. plant. 1891, p. 898.

Cells moderately large, twice or rather more than twice as long as broad, deeply constricted, sinus

narrowly linear with a dilated extremity; semicells pyramidate with a truncate apex and sinuate margins, sometimes almost five-lobed; basal angles broadly rounded, rounded-rectangular, or even retuse; lateral margins with two hollows, sometimes slight and sometimes fairly deep, often unequal; apical part of cell standing out as a polar lobe, subtruncate at the apex with rounded angles, and with a deep linear incision in the middle; semicells with three protuberances across the base and two across the middle. Side view of semicell elongate-pyramidate, basal angles subrectangular, somewhat wider above the base, then tapering upwards to the apex, which is truncate with rounded angles. Vertical view elliptical, with three protuberances on each side, the two upper protuberances which show in the middle of the lateral margin alternating with the three lower ones; polar lobe broadly elliptic. Cell-wall punctate.

Zygospore globose, furnished with numerous, blunt, somewhat curved papillæ.

Length 130–195 μ; breadth 70–91 μ; breadth of isthmus 16–27 μ; thickness 42–45 μ; diam. zygosp. without papillæ 73·6–86 μ; length of papillæ 9–13 μ.

England.—Cumberland! Westmoreland (at 2,400 ft. on Helvellyn)! (*Ralfs*). W. and N. Yorks! Lancashire (zygospores from near Wrynose)! Leicestershire (*Roy*). Wilts! Warwick (*Wills*). Surrey! Sussex (*Ralfs*). Kent! (*Ralfs*). Hants! (*Ralfs*). Devon! (*Bennett*). Cornwall! (*Ralfs*).

Wales.—Fairly general!

Scotland! General! (*Roy & Bissett*). Zygospores at Dalwhing near Aboyne, Aberdeen (*Roy & Bissett*). Common in Outer Hebrides! Orkneys!

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Zygospores from Carrick Mountain (*Archer*). Down! Londonderry!

Geogr. Distribution.—France. Germany. Austria and Galicia. Italy. Norway. Sweden. Denmark. Bornholm. Finland. Poland (var). N. and S. Russia.

Faeroes. Greenland. India. Ceylon. Azores. United States. Paraguay.

This is one of the most abundant of the large British species of *Euastrum*, and is subject to considerable variation in outward form. The sinuation of the lateral margins of the semicells varies very much, even in the semicells of the same plant. The form named "var. *sinuatum*" by Gay has therefore no claim to rank as a distinct variety. The form named "var. *tatricum*" by Raciborski is based on an error in Ralfs' 'British Desmids.' This is another species in which Ralfs failed to depict the surface protuberances correctly. The only protuberances on the semicell of any specimen of *E. Didelta* are three across the base, the middle one being immediately above the isthmus, and two across the centre.

Monstrosities of this Desmid are not uncommon; they have been figured by Archer in 'Proc. Dubl. Nat. Hist. Soc.,' 1859, p. 208, t. 1, f. 12; 'Nat. Hist. Rev.,' 1859, vi, p. 470, t. 33; by Bulnheim in 'Hewidgia,' 1861, p. 52, t. 9, f. 6; and by West & G. S. West in 'Ann. Bot.,' xii, 1898, t. iv, f. 39.

Some specimens possess a large scrobiculation beneath the two central protuberances; this form has been named "forma *scrobiculata* Nordst.," and is fairly general in its distribution.

7. **Euastrum affine** Ralfs.

(Pl. XXXV, figs. 11, 12.)

Euastrum affine Ralfs in Ann. Mag. Nat. Hist. xiv, 1844, p. 191, t. 7, f. 3; Hass. Brit. Freshw. Alg. 1845, p. 382, t. 90, f. 9; Ralfs Brit. Desm. 1848, p. 82, t. 13, f. 3; Arch. in Pritch. Infus. 1861, p. 729; Rabenh. Flor. Europ. Alg. III, 1868, p. 182; Cooke, Brit. Desm. 1886, p. 67, t. 33, f. 2; De Toni, Syll. Alg. 1889, p. 1091; West, Alg. W. Ireland, 1892, p. 137; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 175; Nordst. Index Desm. 1896, p. 40; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 61; Alg. N. Ireland, 1902, p. 28.

Helierella affinis Kuntze, Revis. gen. plant. 1891, p. 898.

Cells of medium size, somewhat less than twice as long as broad, very deeply constricted, sinus narrowly linear with a dilated extremity; semicells three-lobed with two intermediate lobules, sinuses between the lobes and the lobules deep and widely open; polar lobe outstanding, anvil-shaped, with rounded angles and a convex apex, and with a median linear notch of some

depth; lateral lobes subquadrate, with rounded angles and retuse sides; intermediate lobules mamillate and prominent; semicells with a large protuberance within each lateral lobe, and with four in the centre, two small ones immediately above the isthmus, and two larger ones immediately above them. Side view of semicell subquadrate in the lower half, with retuse sides; upper half pyramidate, with deeply retuse sides and a dilated, rounded-truncate apex; intermediate lobule emarginate; lateral lobes (at base) rhomboidal, with rounded angles and retuse sides. Vertical view elliptic, with four prominent protuberances along each side; intermediate lobules emarginate; polar lobe quadrate-oblong, sides slightly convex, poles deeply emarginate. Cell-wall punctate.

Zygospore unknown.

Length 98–117 μ; breadth 53–64 μ; breadth of isthmus 17–18 μ; thickness 35–38 μ.

England. — Cumberland! Westmoreland! (*Ralfs*). W. and N. Yorks! Lancashire! Surrey! Sussex (*Ralfs*). Hants. (*Ralfs*). Wilts! (*Taturn*). Devon! (*Bennett*). Cornwall (*Marquand*).

Wales.—General in Carnarvonshire (Glyder Fach at 2,200 ft.)! Dolgelly, Merioneth (*Ralfs*).

Scotland. — General, but not abundant! (*Roy & Bissett*). Outer Hebrides!

Ireland. — Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Norway. Sweden. Denmark. N. Russia. India. United States.

E. affine is a very characteristic species and cannot be easily confused with any other. The disposition of the surface protuberances and the form of the polar lobe at once distinguish it from *E. Didelta*. It often occurs in quantity in upland *Sphagnum*-bogs, and is not infrequently associated with *E. ampullaceum*.

Nordstedt has described a "forma *scrobiculata*" of it, with a conspicuous central scrobiculation, but we have not observed this form from Britain.

8. **Euastrum ampullaceum** Ralfs.

(Pl. XXXV, figs. 8–10.)

Euastrum ampullaceum Ralfs, Brit. Desm. 1848, p. 83, t. 13, f. 4 (*Euastrum* without name figured in Hass. Brit. Freshw. Alg. 1845, t. 90, f. 11); Arch. in Pritch. Infus. 1861, p. 729; Rabenh. Flor. Europ. Algar III, 1868, p. 183; Delp. Desm. subalp. 1873, p. 104, t. 6, f. 3, 4; Kirchn. Alg. Schles. 1878, p. 158; Cooke, Brit. Desm. 1886, p. 68, t. 33, f. 3; Hansg. Prodr. Algenfl. Böhm. 1888, p. 205; De Toni, Syll. Alg. 1889, p. 1091; West, Alg. W. Ireland, 1892, p. 137; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott Desm. 1893, p. 175; Nordst. Index Desm. 1896, p. 44; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 61; Alg. N. Ireland, 1902, p. 28.

E. ampullaceum forma *scrobiculata* Nordst. Norges Desm. 1873, p. 8.

Helierella ampullacea Kuntze, Revis. gen. plant. 1891, p. 898.

Cells of medium size, a little more than $1\frac{1}{2}$ times longer than broad, very deeply constricted, sinus narrowly linear and dilated at the extremity; semicells three-lobed; polar lobe cuneate and dilated, with rounded angles, apex convex with a deep and narrow median incision; lateral lobes much larger than the polar lobe, triangular with rounded basal angles, superior margin of the lobes with a mamillate projection, which is sometimes reduced to a rounded elevation; semicells with three protuberances across the base, the median one being emarginate, and with two across the centre, also with three conspicuous scrobiculations disposed between the five protuberances. Side view of semicell elongate-pyramidate, basal angles rectangular and basal part of margins slightly retuse, upper part of margins somewhat concave, apex rounded. Vertical view pointed-elliptic, with four protuberances on each side and a fifth between and beneath the two central ones; mamillate projection of lateral lobes widely emarginate; polar lobe rectangular, with subacute angles and retuse sides. Cell-wall finely scrobiculate.

Zygospore globose or ovoid-globose, ornamented with numerous mamillate projections.

Length 93–110 μ; breadth 57–59 μ; breadth of isthmus 14–17·5 μ; thickness 34–36 μ; diam. zygosp. without mamillate projections 54–72 μ; length of mamillæ 5–6·4 μ.

England.—Cumberland! Westmoreland! (*Ralfs*).

W. and N. Yorks! Lancashire! Surrey! Sussex (*Ralfs*). Kent (*Ralfs*). Hants! (*Ralfs*). Devon! (*Bennett*). Wilts! Cornwall!

Wales.—General through Carnarvonshire (Glyder Fach at 2,200 ft.)! Dolgelly, Merioneth (*Ralfs*).

Scotland.—Sutherland!, Ross!, Inverness!, Aberdeen!, Kincardine!, Forfar!, Perth!, Argyle, Arran, Fife; zygospores near Cambus-o'-May, Aberdeen (*Roy & Bissett*). Skye (with zygospores)! Common in Outer Hebrides! Orkneys!

Ireland.—Donegal! Galway! Mayo! Kerry! Dublin and Wicklow (*Archer*). Down! Antrim!

Geogr. Distribution.—France. Germany. Hungary. Italy. Norway. Sweden. S. Russia. Faeroes. India (var.). United States.

This species is generally distributed throughout the *Sphagnum*-bogs of the British Islands. The general outline in front view and the form of the polar lobe, particularly in the vertical view, are absolutely characteristic. We have examined many thousands of British specimens, and find the three scrobiculations in the centre of the semi-cells very constant, this being the reason we have included Nordstedt's "forma *scrobiculata*" with the type form. Ralfs did not accurately indicate the surface protuberances, and he remarks in his text that they were "indistinct."

9. **Euastrum sinuosum** Lenorm.

(Pl. XXXVI, fig. 1.)

Euastrum sinuosum "Lenormand, in herb." Ralfs, Brit. Desm. 1848, p. 85; Lund. Desm. Suec. 1871, p. 20; Nordst. Alg. aq. dulc. et Char. Sandvic. 1878, p. 14; Cooke, Brit. Desm. 1886, p. 71, t. 34, f. 3; Nordst. Freshw. Alg. N. Zeal. 1888, p. 33; De Toni, Syll. Alg. 1889, p. 1098; Börg. Desm. Brasil. 1890, p. 33, t. 3, f. 16; West, Alg. W. Ireland, 1892, p. 138; Alg. Eng. Lake Distr. 1892, p. 723; Roy & Biss. Scott. Desm. 1894, p. 178; Nordst. Index Desm. 1896, p. 235; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 61; Freshw. Chlorophy. Koh Chang, 1901, p. 168; Alg. N. Ireland, 1902, p. 28; Freshw. Alg. Ceylon, 1902, p. 148.

Euastrum circulare Hass. var. *β* Ralfs, Brit. Desm. 1848, p. 85, t. 13, f. 5 *a*, *b*, and *d*.

E. circulare C. *Falesiensis* Bréb. Liste Desm. 1856, p. 122 (Ralfs, Brit. Desm. t. 14, f. 3 *b* and *c*).

E. circulare β sinuosum Hansg. Prodr. Algenfl. Böhm. 1888, p. 206.

Helierella sinuosa Kuntze, Revis. gen. plant. 1891, p. 899.

Cells small, about $1\frac{3}{4}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells three-lobed; polar lobe prominent and outstanding, quadrate-cuneate, angles rounded, apex truncate with a narrow median incision of some depth; lateral lobes bilobulate, lobules rounded, separated by a widely-open sinus, the upper one not projecting so far out as the lower; semicells with three protuberances across the base and two across the centre. Side view of semicell pyramidate with a quadrate base, upper part of lateral margins slightly retuse, apex rounded-truncate. Vertical view elliptic, with three protuberances on each side, and the two central ones showing above and between them; polar lobe oblong-rectangular, poles retuso-emarginate. Cell-wall finely punctate, punctulations often scarcely visible.

Zygospore unknown.

Length 56–78 μ; breadth 35–46 μ; breadth of isthmus 9–15 μ; thickness 21–30 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W. and N. Yorks! Lancashire! Surrey! Hants! (*Ralfs*). Devon!

Wales.—Capel Curig, Snowdon, and Llyn-y-cwm-ffynon, Carnarvonshire!

Scotland.—General, but rare (*Roy & Bissett*). Rhiconich and Loch Culag, Sutherland! L. Luichart, Ross! Outer Hebrides! Shetlands!

Ireland.—Donegal! Galway! Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Austria and Galicia. Italy. Norway. Sweden. Denmark. Poland. S. Russia. Faeroes. India. Ceylon (var.). Siam. Singapore. Java. Australia. New Zealand. Central Africa. Sandwich Islands. United States. Guiana. Brazil.

Much confusion has existed concerning the nomenclature of this characteristic *Euastrum*. It has been referred by many authors to "*Euastrum circulare* Hass." as a variety, but the latter species does not exist, Hassall's figure being

most probably a very erroneous drawing of *Euastrum ansatum* Ralfs.

It is a variable species with regard to the depth of the sinuations of the margins, and for this reason we have included "var. *Falesiensis* Bréb." as part of the type.

The five protuberances, three basal and two central, sometimes each possess a conspicuous central scrobiculation, and rarely, similar scrobiculations are found between the protuberances.

The zygospore of *E. sinuosum* var. *simplex* Mask. has been described and figured as "globose, with simple stout spines." Consult Maskell, 'Further Notes New Zeal. Desm.' 1888, p. 11, t. 1, f. 6.

Var. **reductum** West & G. S. West. (Pl. XXXVI, figs. 2, 3.)

E. sinuosum var. *reductum* West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 83; Desm. Singapore, 1897, p. 160, t. 8, f. 17; Freshw. Alg. Ceylon, 1902, p. 148.

Cells somewhat smaller than in the type, polar lobe not dilated, lateral lobules less prominent; in vertical view protuberances considerably reduced, and polar lobe quadrate-oblong without emarginate poles.

Length 46–59 μ; breadth 24–32·5 μ; breadth of isthmus 7·5–9·5 μ; thickness 15–18 μ.

England.—Thursley Common, Surrey!

Ireland.—Ballynahinch, Galway!

Geogr. Distribution.—Ceylon. Singapore. W. Africa.

10. **Euastrum Jenneri** Arch.

(Pl. XXXVI, fig. 4.)

Euastrum circulare var. γ Ralfs, Brit. Desm. 1848, p. 85, t. 13, f. 5 *c*.
E. circulare var. *Ralfsii* Bréb. Liste Desm. 1856, p. 122; Rabenh. Flor. Europ. Algar. III, 1868, p. 183; Cooke, Brit. Desm. 1886, p. 72, t. 34, f. 4; Nordst. Index Desm. 1896, p. 150; West & G. S. West, Alga-fl. Yorks. 1900, p. 62.
E. Jenneri Arch. in Pritch. Infus. 1861, p. 730.

This species differs from *E. sinuosum* in the broader polar lobes; in the larger lateral lobes, which are more quadrate, with equal lobules; and in the surface protuberances, of which there are eleven, a basal row

of four, a median row of three, then a row of four across the upper part of the lateral lobes. Cell-wall punctate.

Zygospore unknown.

Length 72 μ; breadth 45 μ; breadth of isthmus 15 μ.

England.—Westmoreland (*Ralfs*). Strensall Common, N. Yorks!

Ireland.—Ballynahinch, Galway!

Geogr. Distribution.—France. United States.

We have only seen this Desmid on two occasions and have not yet succeeded in obtaining side or vertical views. It may only be a variety of *E. sinuosum*, but this point cannot well be decided until the other views have been obtained.

11. **Euastrum aboense** Elfv.

(Pl. XXXVI, figs 5, 6.)

Euastrum aboense Elfv. Anteck. Finska Desm. 1881, p. 7, t. 1, f. 2; De Toni, Syll. Alg. 1889, p. 1103; Roy & Biss. Scott. Desm. 1894, p. 175; Nordst. Index Desm. 1896, p. 36; West & G. S. West, Notes Alg. III, 1903.

E. inerme (Ralfs) Lund. var. *aboense* Racib. Nonn. Desm. Polon. 1885, p. 92.

Helierella aboensis Kuntze, Revis. gen. plant. 1891, p. 898.

Cells small, about $1\frac{1}{2}$ times longer than broad, very deeply constricted, sinus narrowly linear with a slightly-dilated extremity; semicells pyramidate-rounded (faintly subrectangular), lateral margins sinuate, with two shallow hollows and a somewhat broad rounded projection in between; apex subtruncate with rounded angles and a narrow median incision; semicells with a slight depressed protuberance above the isthmus and two others across the centre, also with 11–13 conspicuous scrobiculations disposed more or less in a regular pattern across the broad part of the semicell. Side view of semicells quadrate at the base, with rounded angles and retuse sides; upper portion shortly pyramidate with a rounded-truncate apex. Vertical view elliptic, with two slight protuberances in the middle of each side.

Zygospore unknown.

Length 58–65 μ; breadth 37–42 μ; breadth of isthmus 11·5–13 μ; thickness 24–25 μ.

Wales.—Capel Curig, and Llyn-y-cwm-ffynon, Carnarvonshire !

Scotland.—On Ben Muich Dhui, near Loch Etchachan, Aberdeen (*Roy & Bissett*).

Geogr. Distribution.—Finland.

E. aboense differs from *E. inerme* in its slightly larger size, in the relatively greater width of the semicells, in the rounded basal angles, and in the scrobiculations on the front of the semicells. The small thickened protuberance which is situated just above the isthmus in the semicells of *E. inerme*, is represented by a very slight protuberance in *E. aboense*. The side and vertical views also differ slightly. It is a species rarely met with.

12. **Euastrum inerme** (Ralfs) Lund.

(Pl. XXXVI, figs. 7, 8.)

Euastrum elegans β *inerme* Ralfs, Brit. Desm. 1848, p. 89, t. 14, f. 7 *e*; Rabenh. Flor. Europ. Algar. III, 1868, p. 186; Kirchn. Alg. Schles. 1878, p. 159; Hansg. Prodr. Algenfl. Böhm. 1888, p. 207.

Euastrum inerme Lund. Desm. Suec. 1871, p. 20, t. 2, f. 3; Cooke, Brit. Desm. 1886, p. 75, t. 35, f. 4; De Toni, Syll. Alg. 1889, p. 1103; West, Alg. W. Ireland, 1892, p. 139; Roy & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 146; West & G. S. West, Alg. S. England, 1897, p. 484; Alg. N. Ireland, 1902, p. 29.

E. inerme a. *Ralfsii* Racib. Nonn. Desm. Polon. 1885, p. 92.

E. inerme c. *Lundellii* Racib. l.c.

Helierella inermis Kuntze, Revis. gen. plant. 1891, p. 898.

Cells small, subelliptic in outline, about $1\frac{3}{4}$ times longer than broad, very deeply constricted, sinus narrowly linear with a slightly-dilated extremity; semicells subpyramidate, basal angles obliquely truncate so that the widest part of the semicell is above the base; lateral margins with two slight hollows, having a broad, rounded projection between; apex slightly protracted, truncate, with a deep and narrow median notch; semicells with a small thickened protuberance in the middle immediately above the isthmus, having two small protuberances across the centre and a large scrobiculation between them. Side view of semicell pyramidate with a subquadrate base; lateral margins slightly retuse

near the base and also towards the apex, with a scrobiculation showing at the middle of the margin on each side; basal angles of semicell quadrate. Vertical view elliptic, with two protuberances on each side, and a third smaller one showing between and beneath them; also with the scrobiculation between the central protuberances on each side. Cell-wall very finely punctate.

Zygospore unknown.

Length 50–62 μ; breadth 30–40 μ; breadth of isthmus 7·5–13 μ; thickness 20–23·5 μ.

England. — Loughrigg, Westmoreland (*Bennett*). Thursley Common, Surrey! Dartmoor, Devon!

Scotland.—Sutherland!, Ross!, Inverness!, Aberdeen!, Kincardine, Forfar, Perth!, Argyll, Arran (*Roy & Bissett*). Often abundant in the Outer Hebrides!

Ireland.—Loughs Clogher and Machugh, and near Glenties, Donegal! Ballynahinch, Loughs Athry, Aunierin, and Derryclare, Galway! Glengariff, Adrigole, and Castletown, Kerry!

Geogr. Distribution.—Germany. Austria and Galicia. Italy. Norway. Sweden. Denmark. Poland. S. Russia. Faeroes. United States.

E. inerme is a rare species in England and Wales, but often occurs in great abundance in the west of Scotland, the Outer Hebrides, and the west of Ireland. In these situations it is frequently associated with large numbers of *E. ventricosum*.

It is a species of definite and constant shape, with very characteristic markings, and it cannot well be mistaken for any other British species of the genus. Ralfs was greatly in error in associating it with *Euastrum elegans*, a species with which it has no close affinity.

13. **Euastrum cuneatum** Jenner.

(Pl. XXXVI, fig. 9.)

Euastrum cuneatum Jenner in Ralfs' Brit. Desm. 1848, p. 90, t. 32, f. 3 *a*; Arch. in Pritch. Infus. 1861, p. 931; Rabenh. Flor. Europ. Algar. III, 1868, p. 187 (formæ *a* et *b*); Nordst. Norges Desm. 1873, p. 9; Cooke, Brit. Desm. 1886, p. 76, t. 34, f. 6; Wolle, Freshw. Alg. U.S. 1887, p. 37, t. 58, f. 12, 13; West, Alg. W. Ireland, 1892, p. 137; Alg. Eng. Lake Distr. 1892, p. 723; Roy & Biss. Scott. Desm. 1893, p. 176; Nordst.

Index Desm. 1896, p. 93; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 62; Alg. N. Ireland, 1902, p. 28.
Helierella cuneata Kuntze, Revis. gen. plant. 1891, p. 898.
Euastrum cuneatum forma *punctata* Schmidle, Beitr. Algenfl. Rheineb. u. Schwarzwald, 1895, p. 80.

Cells moderately large, more than twice as long as broad, deeply constricted, sinus narrowly linear with the extremity dilated; semicells narrowly pyramidate, basal angles slightly rounded and often a little thickened, lateral margins almost straight (generally faintly sinuate), apical angles slightly rounded, apex truncate with a narrow and fairly-deep median incision; semicells without protuberances, or with a very slight swelling within each basal angle. Side view of semicell ovate-pyramidate, apex truncately rounded. Vertical view broadly elliptic, lateral margins convex or very slightly triundulate. Cell-wall finely scrobiculate.

Zygospore unknown.

Length 96–128 μ; breadth 47–59 μ; breadth of isthmus 13–22 μ; thickness 42 μ.

England.—Cumberland! Westmoreland! (*Bissett*). W. and N. Yorks! Lancashire! Surrey! Sussex (*Ralfs*). Hants (*Bennett*).

Wales.—General throughout Carnarvonshire! Ffestiniog!, and Dolgelly (*Ralfs*), Merioneth.

Scotland.—Sutherland, Ross, Inverness, Aberdeen!, Kincardine, Forfar, Perth!, Dumfriesshire (*Roy & Bissett*). Kirkcudbright! Outer Hebrides!

Ireland.—Near Loughs Glentornan and Macgrath, Donegal! Jar Connaught and near Oughterard, Galway! Carrantuohill, Kerry! Dublin and Wicklow, (*Archer*). Lough Fea, Londonderry!

Geogr. Distribution.—France. Germany. Galicia in Austria. Norway. Sweden. N. Russia. Greenland. Australia. New Zealand (var.). United States.

This characteristic species is often abundant amongst submerged *Sphagnum* in association with *E. ampullaceum*, *Cosmarium Cucurbita*, *Micrasterias truncata*, *Eremosphæra viridis*, and other Algæ. We do not know of any *near* relatives to *E. cuneatum*. The broadly-truncate apices, pyramidate semicells, and absence of protuberances are all peculiar features.

The basal view of the semicell given by Ralfs (*l.c.* t. 32, f. 3*b*) is incorrect. We have examined hundreds of specimens of this species and the vertical view is broadly elliptic, occasionally exhibiting the merest trace of three undulations along each side.

14. **Euastrum ansatum** Ralfs.

(Pl. XXXVI, figs. 10–13.)

? *Euastrum circulare* Hass. Brit. Freshw. Alg. 1845, p. 383, t. 90, f. 5 (figure bad); Ralfs, Brit. Desm. 1848, p. 85, t. 14, f. 3*a* (from Hassall); Arch. in Pritch. Infus. 1861, p. 729; Cooke, Brit. Desm. 1886, p. 71, t. 34, f. 2 (from Hassall or Ralfs); De Toni, Syll. Alg. 1889, p. 1097; West, Alg. W. Ireland, 1892, p. 138; Alg. Eng. Lake Distr. 1892, p. 723.

E. ansatum Ralfs, Brit. Desm. 1848, p. 85, t. 14, f. 2 [Not *E. ansatum* Ehrenb., 1832, which is *Cosmarium ansatum* (Ehrenb.) Rabenh.]; Arch. in Pritch. Infus. 1861, p. 729; Lund. Desm. Suec. 1871, p. 20; Kirchn. Alg. Schles. 1878, p. 158; Cooke, Brit. Desm. 1886, p. 70, t. 33, f. 5; Hansg. Prodr. Algenfl. Böhm. 1888, p. 206; De Toni, Syll. Alg. 1889, p. 1096; West, Alg. W. Ireland, 1892, p. 138; Roy & Biss. Scott. Desm. 1893, p. 176; Nordst. Index Desm. 1896, p. 46; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 62; Alg. N. Ireland, 1902, p. 28; Scott. Freshw. Plankton, I, 1903, p. 525.

Cosmarium circulare Kütz. Spec. Alg. 1849, p. 174.

Euastrum circulare D. *Hassallii* Brêb. Liste Desm. 1856, p. 122.

Didymidium (*Euastrum*) *ansatum* Reinsch, Algenfl. Franken, 1867, p. 130.

Euastrum Ralfsii Rabenh. Flor. Europ. Algar. III, 1868, p. 184.

E. ansatum var. *sublobatum* Delp. Desm. subalp. 1873, p. 103, t. 6, f. 35–36.

Helierella circularis Kuntze, Revis. gen. plant, 1891, p. 898.

H. ansata Kuntze, l.c.

Cells somewhat small, about twice as long as broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells pyramidate with a broad base, basal angles rounded, lower part of lateral margins convex with a slight undulation above the basal angles, upper part of margins concave, apex rotundo-truncate, with a narrow and fairly deep median incision; semicells with a slight protuberance immediately above the isthmus and two rather larger ones across the centre. Side view of semicell elongate-pyramidate, with a protuberance just above the base on each side, upper part of margins concave, apex rounded. Vertical view elliptic, poles broadly triangular with rounded angles; with two protuberances in the middle on each side, and a third one between and beneath them; polar lobe broadly elliptic-oblong. Cell-wall punctate, punctulations in vertical lines.

Zygospore globose, ornamented with numerous bluntly-rounded (or abruptly-sharp-pointed) spines.

Length 70–91 μ; breadth 32–47 μ; breadth of isthmus 12–15 μ; thickness 26–29 μ; diam. zygosp. without papillæ 38·4–55·5 μ; length of papillæ 5–6·4 μ.

England. — Cumberland! Westmoreland! (*Ralfs*). W., N., and E. Yorks! Lancashire! (*Ralfs*). Cheshire (*Ralfs*). Leicestershire (*Roy*). Warwickshire (*Wills*). Gloucestershire (*Ralfs*). Surrey! (*Ralfs*). Sussex (*Ralfs*). Kent! Hants! (*Ralfs*). Devon! (*Bennett*). Cornwall! (*Ralfs*).

Wales. — General and abundant (at 2,200ft. on Glyder Fach, Carnarvonshire)!

Ireland.—General!

Scotland.—General and abundant! (*Roy & Bissett*). Outer Hebrides! Orkneys! Shetlands! Often in the plankton!

Geogr. Distribution.—France. Belgium. Germany. Austria and Galicia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. N. and S. Russia. Faeroes. Iceland. Greenland. Central China. Japan. India. Ceylon. Burmah (var.) Siam. Singapore. Sumatra. Java. Australia (form). New Zealand. Madagascar. E. Africa. Azores. Sandwich Islands. United States. W. Indies (var). Brazil. Paraguay.

E. ansatum is one of the most generally distributed of the British species of the genus. The "*Euastrum ansatum*" described by Ehrenberg in 1832 is a *Cosmarium* which is now known to occur in several parts of the world. The "*Euastrum ansatum*" as known to all recent authors is the one originally described by Ralfs in his 'British Desmids,' and therefore Ralfs must be regarded as the authority for this species.

The Desmid partly described and figured by Hassall under the name of "*Euastrum circulare*" is most probably a form of *E. ansatum*, as was pointed out by Lundell in 1871. Hassall's description, however, is so poor and his figure so bad, that certain identification is impossible.

The zygospores observed by Roy appear to have differed somewhat from those we have ourselves observed. Roy describes the zygospores as furnished with numerous "short,

stout, abruptly-sharp-pointed spines," whereas we find them covered with short, stout, blunt papillæ.

The undulation at the sides of the semicells varies very much, so that we find it impossible to clearly define the "var. *sublobatum*" of Delponte.

Var. **pyxidatum** Delp. (Pl. XXXVI, figs. 14, 15.)

E. ansatum var. *pyxidatum* Delp. Desm. subalp. 1873, p. 103, t. 6, f. 32–34; De Toni, Syll. Alg. 1889, p. 1097.

Semicells almost three-lobed owing to the large development of the undulation above the basal angles, upper portion of lateral margins deeply sinuate, "polar lobe" subquadrate with rounded angles.

Length 65–86 μ; breadth 33–42 μ; breadth of isthmus 12–14 μ; thickness 22–27 μ.

Scotland.—"Common" (*Roy & Bissett*). We find it very rare!

Ireland.—Galway!

Geogr. Distribution.—Poland. Italy.

15. **Euastrum obesum** Josh.

(Pl. XXXVI, figs. 16, 17.)

Euastrum obesum Josh. Burmese Desm. 1886, p. 638, t. 23, f. 19, 20; De Toni, Syll. Alg. 1889, p. 184; Nordst. Index Desm. 1896, p. 184; West & G. S. West, Alga-fl. Yorks. 1900, p. 62.
Helierella obesa Kuntze, Revis. gen. plant. 1891, p. 899.

Cells of medium size, about twice as long as broad, deeply constricted, sinus narrowly linear; semicells pyramidate, with broadly-rounded basal angles, lower part of lateral margins convex, upper part slightly concave, apex widely subtruncate with rounded angles having a narrow median incision. Side view of semicell ovate-pyramidate, apex rounded. Vertical view broadly elliptical, lateral margins very slightly biundulate. Cell-wall smooth.

Zygospore unknown.

Length 50–111 μ; breadth 30–59 μ; breadth of apex 17–28 μ; breadth of isthmus 9–21 μ.

England.—Mossdale Moor, Widdale Fell, N. Yorks (large specimens)!

Geogr. Distribution.—India. Burmah. Singapore (var.). Sumatra. Madagascar (var.).

All the examples of this species which we have seen possessed a smooth cell-wall. Turner also found that Indian specimens had a smooth cell-wall; his measurements are:—length 58–65 μ; breadth 37–44 μ; breadth of isthmus 16–17 μ. Joshua describes the cell-wall as of "a faint flesh-colour, sometimes indistinctly granulated." His original measurements are:—length 50–80 μ; breadth 30–35 μ; breadth of isthmus 9–15 μ.

It is distinguished from *E. ansatum* by its relatively-greater breadth and by the broadly-rounded basal part of the semicells. There is also an absence of the longitudinal lines of punctulations which are such a characteristic feature of *E. ansatum*.

16. **Euastrum pingue** Elfv.

(Pl. XXXVII, fig. 1.)

Euastrum sp. Arch. in Quart. Journ. Micr. Sci. 1871, p. 93 (according to Roy).
Euastrum pingue Elfv. Anteck. Finska Desm. 1881, p. 7, t. 1, f. 3; Wolle, Desm. U.S. 1884, p. 105, t. 27, f. 1–3; De Toni, Syll. Alg. 1889, p. 1098; Roy & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 201.
E. Armstrongianum Arch. in Ann. Mag. Nat. Hist. 1883, p. 213.
Helierella pinguis Kuntze, Revis. gen. plant. 1891, p. 899.

Cells small, almost $1\frac{1}{2}$ times longer than broad, very deeply constricted, sinus slightly open for more than half its length, then narrowed; semicells rounded-pyramidate, basal angles broadly rounded (faintly subrectangular) upper portions of lateral margins retuse; apex convexo-truncate, with a widely-open, shallow, median notch. Cell-wall scrobiculate; scrobiculations larger in the centre of the semicells, at the apex, and at the basal angles, causing these parts of the cell-wall to appear rough on the surface; with a larger, somewhat irregular scrobiculation in an excentric position near the centre of the semicells. Semicells with a small papilla at each basal angle at the beginning of the sinus; also with a large granule in the middle and close to the isthmus. Side view of semicell ovate, apex rounded, sides slightly retuse just below the apex; with a granule at each side at the base, close to

the isthmus. Vertical view elliptic, with rounded poles, slightly inflated in the middle on each side.

Zygospore unknown.

Length 56–60 μ; breadth 40–41 μ; breadth of apex 19–21 μ; breadth of isthm. 9·6–12 μ; thickness 26–28 μ.

Scotland.—Near Cambus-o'-May, Aberdeen; Glen Clova, Forfar; Glen Coe, Argyll (*Roy & Bissett*). Rhiconich, Sutherland!

Ireland.—Connemara, Galway (*Archer*).

Geogr. Distribution.—Finland. United States.

17. **Euastrum insigne** Hass.

(Pl. XXXVII, figs. 2–5.)

Euastrum insigne Hass. Brit. Freshw. Alg. 1845, p. 21, t. 91, f. 2; Ralfs, Brit. Desm. 1848, p. 83, t. 13, f. 6; Arch. in Pritch. Infus. 1861, p. 729, t. 3, f. 12; Rabenh. Flor. Europ. Algar. III, 1868, p. 184; Kirchn. Alg. Schles. 1878, p. 158; Cooke, Brit. Desm. 1886, p. 69, t. 33, f. 4; Hansg. Prodr. Algenfl. Böhm. 1888, p. 206; De Toni, Syll. Alg. 1889, p. 1092; West, Alg. N. Wales, 1890, p. 287; Alg. W. Ireland, 1892, p. 137; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 177; West & G. S. West, Some N. Amer. Desm. 1896, p. 242; Nordst. Index Desm. 1896, p. 147; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 62; Alg. N. Ireland, 1902, p. 28.

Didymidium (*Euastrum*) *insigne* Reinsch, Algenfl. Franken, 1867, p. 130.

Euastrum mammillosum Wolle in Bull. Torr. Bot. Club. 1883, p. 18, t. 27, f. 21; Desm. U. S. 1884, p. 102, t. 26. f. 14, 15 (figures bad); De Toni, Syll Alg. 1889, p. 1078.

E. insigne b. *typicum* Racib. Nonn. Desm. Polon. 1885, p. 92.

E. insigne c. *montanum* Racib. l. c. t. 13, f. 1.

Helierella insignis Kuntze, Revis. gen. plant. 1891, p. 898.

H. mammillosa Kuntze, l. c. p. 899.

Euastrum insigne var. *elegans* Schmidle Beitr. Alg. Schwarzwald. 1893, p. 105, t. 6, f. 7, 8.

E. insigne var. *mammillosum* (Wolle) Turn. Freshw. Alg. E. India, 1893, p. 79.

Cells of medium size, about twice as long as broad, deeply constricted, sinus widely open, narrowed towards the extremity; semicells widely deltoid in the basal portion, then narrowed into a neck, which widens again into an obversely-deltoid apex, basal and apical angles rounded, frequently with an undulation on the margin just above the basal angle, apex truncate with a narrow median incision; semicells with a large, submamillate, downwardly-directed protuberance within

each basal angle, which projects over the edge of the sinus. Side view of semicell elongate-pyramidate, angles at base submamillate, lower part of sides convex, upper part of sides concave; with a dilated apex, the angles of which are bluntly mamillate and upwardly directed. Vertical view oblong-rectangular, with a conical-mamillate protuberance in the middle of each truncate pole, lateral margins retuse in the centre; polar lobe in the form of an oblique cross, the four processes of which are mamilliform. Cell-wall scrobiculate, scrobiculations larger at all the angles, the surfaces of which become rough (sometimes almost papillate).

Zygospore unknown.

Length 108–135 μ; breadth 57–70 μ; breadth of apex 29–37 μ; breadth of isthmus 13–15·5 μ; thickness 32–36 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). Lancashire! W. and N. Yorks! Surrey! Hants. (*Ralfs*). Devon! (*Bennett*).

Wales.—Common in Carnarvonshire (up to 2,200 ft. on Glyder Fach) and Merioneth!

Scotland.—Sutherland!, Ross, Inverness!, Banff, Aberdeen!, Kincardine, Forfar!, Perth!, Argyll, Arran (*Roy & Bissett*). Harris and Lewis, Outer Hebrides!

Ireland.—Glen Caragh, Cromagloun, and Torc Mt., Kerry! Pool near Lough Glentornan, Donegal! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Austria and Galicia. Hungary. Norway. Sweden. Finland. Poland. Faeroes. United States.

This species is often abundant in mountain bogs and the boggy margins of mountain tarns, in which situations it is commonly found amongst the leaves of a submerged form of *Sphagnum cuspidatum*. It exhibits considerable variation in the length of the "neck" and in the form of the basal angles of the semicells. These variations are connected by every intermediate state, so that it is impossible to clearly define such forms as "var. *montanum* Racib." or "var. *elegans* Schmidle." The Desmid described and figured by Wolle

from the United States as "*Euastrum mammillosum*" is a bad illustration of a form of *E. insigne*. The plant that Wolle figures as *E. insigne* is now known as *E. orientale* Turn. Wolle never appeared to clearly understand the nature of *Euastrum insigne* Hass.

18. **Euastrum intermedium** Cleve.

(Pl. XXXVII, fig. 6.)

Euastrum intermedium Cleve, Sverig. Desm. 1864, p. 484, t. 4, f. 1; Lund. Desm. Suec. 1871, p. 21, t. 2, f. 4; De Toni, Syll. Alg. 1889, p. 1093; Eichler, Mat. flor. Miedz. 1893, p. 61; 1894, p. 130; Roy & Biss. Scott. Desm. 1893, p. 177; West & G. S. West, Some N. Amer. Desm. 1896, p. 242, t. 14, f. 18, 19 (forma); Nordst. Index Desm. 1896, p. 148.
E. insigne b. *intermedium* Rabenh. Flor. Europ. Algar. III, 1868, p. 184.
Holocystis intermedia Benn. Freshw. Alg. Eng. Lake Distr. 1886, p. 8.
Helierella intermedia Kuntze, Revis. gen. plant. 1891, p. 898.

Cells small, almost $1\frac{3}{4}$ times as long as broad, deeply constricted, sinus widely open but narrowed at the extremity; semicells three-lobed, with a large open sinus between the polar and lateral lobes; lateral lobes obtusely conical; polar lobe somewhat anvil-shaped, angles acutely rounded, apex convexo-truncate with a narrow median incision; semicells with two protuberances across the middle of the basal half (between the two lateral lobes), and with two very small protuberances on the polar lobe, one on each side of the median incision. Side view of semicell elongate-pyramidate, with a protuberance on each side near the base, lateral margins concave, and with a slight swelling on each side of the apex, which is rounded (or rounded-truncate). Vertical view elliptical, poles acutely rounded, with two prominent protuberances on each side near the middle; polar lobe elliptical, with two slight swellings on each side near the middle. Cell-wall smooth.

Zygospore unknown.

Length 54–68 μ; breadth 31–40 μ; breadth of apex 20–26 μ; breadth of isthmus 9–10 μ; thickness 20–25 μ.

England.—Cumberland (*Bennett*).

Scotland.—Loch Inver, Sutherland!; Poolewe, Ross; South Birsemore, Aberdeen; Glen Clova, Forfar; Arnbathie Loch, Perth; Glen Coe, Argyll (*Roy & Bissett*). Rhiconich, Sutherland!

Geogr. Distribution.—Norway. Sweden. Poland. Greenland. Ceylon (var.). Azores. United States.

19. **Euastrum Webbianum** Turn.

(Pl. XXXVII, fig. 7.)

Euastrum Webbianum Turn. Freshw. Alg. E. India, 1893, p. 86 (formæ *major* et *minor*), t. 22, f. 4; Turn. Desmid Notes, 1893, p. 343, f. 4 (forma *major*).

Cells rather small, about twice as long as broad, deeply constricted, sinus widely open but narrowed towards the extremity; semicells subpyramidate, with concave sides, and projecting, subconical (slightly upturned) basal angles, apex truncate with a narrow median incision. Cell-wall smooth.

Forma *minor*: length 26–30 μ; breadth 13–16 μ; breadth of isthmus 4 μ.

Forma *major*: length 58 μ; breadth 28 μ; breadth of isthmus 8 μ.

England. — Sutton Park, Warwick (forma *major*, *Turner*).

Geogr. Distribution.—N. India (forma *minor*).

This small "*Euastrum*," which has been but imperfectly described by Turner, appears to us as very probably two dislocated cells (each in an oblique position) from a filament of *Desmidium Swartzii* or some allied species.

20. **Euastrum Sendtnerianum** Reinsch.

(Pl. XXXVII, fig. 8.)

Euastrum Sendtnerianum Reinsch, Spec. Gen. Alg. 1867, p. 119, t. 21, f. C. II 1–6; De Toni, Syll. Algar. 1889, p. 1079.

Didymidium (*Euastrum*) *Sendtnerianum* Reinsch, Algenfl. Frank. 1867, p. 135, t. 9, f. 4.

Cosmarium (*Euastrum*) *Sendtnerianum* Wolle in Bull. Torr. Bot. Club. 1885, p. 3, t. 47, f. 30–31; Wolle, Freshw. Alg. U.S. 1887, p. 29, t. 57, f. 30, 31; Gutw. Flor. Glon. Okolic Lwowa, 1891, p. 40.

Helierella Sendtneriana Kuntze, Revis. gen. plant. 1891, p. 899.

Cells very small, about twice as long as broad, oblong-elliptic in outline, deeply constricted, sinus narrowly linear and dilated at the extremity; semicells semi-elliptic, with four undulations up each side and an emarginate apex. Side view of semicell ovate-elliptic; vertical view elliptic. Cell-wall smooth.

Zygospore unknown.

Length 23–27 μ; breadth 12–15 μ; breadth of isthmus 4 μ; thickness 6–8 μ.

Geogr. Distribution.—Germany. Galicia in Austria.

The typical form of this species is unknown in the British Islands. Gutwinski gives as the measurements of his Austrian specimens: length 29 μ; breadth 17 μ; breadth of isthm. 7 μ. The figure we give is exceedingly poor, but as it is an exact copy of Reinsch's original, this could only be expected.

Var. **latius** Roy & Biss.

E. Sendtnerianum var. *latius* Roy & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 232.

Larger than the type, with broader apices.

Length 43·2 μ; breadth at base of semicells 25·6 μ, at apex 19·2 μ.

Scotland.—Near Den of Maidencraig, Aberdeen (*Roy & Bissett*).

We are unacquainted with this variety and are unable to give a figure of it.

21. **Euastrum rostratum** Ralfs.

(Pl. XXXVII, figs. 11–13.)

Euastrum rostratum Ralfs in Ann. Mag. Nat. Hist. 1844, p. 192, t. 7, f. 5; Hass. Brit. Freshw. Alg. 1845, p. 382, t. 91, f. 8; Ralfs, Brit. Desm. 1848, p. 88, t. 14, f. 6; Arch. in Pritch. Infus. 1861, p. 730, t. 1, f. 26; Cooke, Brit. Desm. 1886, p. 73, t. 35, f. 2 (figures partly copied from Ralfs, and bad); De Toni, Syll. Alg. 1889, p. 1099; ? West, Freshw. Alg. W. Ireland, p. 138; Roy & Biss. Scott. Desm. 1893, p. 177; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks, 1900, p. 62.

E. elegans b. *rostratum* Rabenh. Flor. Europ. Algar. III, 1868, p. 186.

Helierella rostrata Kuntze, Revis. gen. plant. 1891, p. 899.

Cells small, a little more than $1\frac{1}{2}$ times longer than broad, very deeply constricted; sinus narrowly linear,

dilated at the extremity and slightly open outwards; semicells subpyramidate in outline, more or less three-lobed; polar lobe quadrate-cuneate, apex convex with a deep and open median notch, a short, blunt spine at each outer angle, and a thickening at each angle of the apical notch; lateral lobes bilobulate, upper lobule rounded and submamilliform, or subquadrate and emarginate, upwardly directed, lower lobule emarginate or bluntly tridentate, horizontally disposed; semicells with a large protuberance in the centre above the isthmus, a large rounded wart on each side of the apical incision and near the base of the polar lobe, a small wart within each lower lateral lobule, and one or two small granules within both upper and lower lateral lobules. Side view of semicell ovate-pyramidate, apex rounded, with a prominent protuberance on each side near the base, and a wart on each lateral margin half-way between the basal protuberance and the apex. Vertical view elliptic, with angular poles and a large protuberance in the middle on each side. Cell-wall smooth.

Zygospore globose, furnished with simple, blunt spines.

Length 39–49 μ; breadth 25–35·5 μ; breadth of isthmus 6·5–8 μ; thickness 20–24 μ.

England.—Westmoreland! (*Ralfs*). N. and E. Yorks! Lancashire! Warwick (*Wills*). Sussex (*Ralfs*). Hants (*Bennett*). Devon! Cornwall! (*Ralfs*).

Wales.—Capel Curig, Carnarvonshire (*Roy*). Dolgelly, Merioneth (*Ralfs*).

Scotland.—General but scarce! (*Roy & Bissett*).

Ireland.—Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Galicia in Austria. Norway. Sweden. Denmark. Bornholm. Finland. Poland. N. Russia. Faeroes. Spitzbergen. Greenland. India. Ceylon. Burmah (var.). Australia (var.). New Zealand (var.). Madagascar (var.). United States.

This is a somewhat rare British species with very distinctive characters, one of the most prominent being the *large smooth protuberance* in the centre near the base of each semicell. The large warts on either side of the apical incision, and near the base of the polar lobe, are also very characteristic, but were overlooked by Ralfs. In fact, the description of this Desmid given by Ralfs is very incomplete, and has caused many observers to go astray with regard to the exact identity of *E. rostratum*.

The *Euastra* figured by Wolle, 'Desm. U. S.' t. 27, figs. 8 and 9, as "*E. rostratum*" do not belong to this species.

Note.—*E. rostratum* var. *cumbricum* Benn. Freshw. Alg. Eng. Lake Distr. II, 1888, p. 5, t. 1, f. 13. It is impossible to say with certainty that Bennett's variety belongs to *E. rostratum*. His figure is too crude and the apex of the semicell is most extraordinary. It would appear to differ principally in the uniformity of the lobulation and the widely excavated apex. Length 45–50 μ; breadth 25 μ.

22. **Euastrum Turnerii** West.

(Pl. XXXVII, figs. 9, 10.)

"*Euastrum* sp. ad. *E. denticulatum* accedens" Nordst. Freshw. Alg. N. Zeal. 1888, p. 35, t. 3, f. 11 [*E. denticulatum* Mask., 1889, non Gay].
Euastrum Turnerii West Alg. W. Ireland, 1892, p. 141, t. 20, f. 18 Nordst. Index Desm. 1896, p. 264; West & G. S. West, Alg. N. Ireland 1902, p. 29.

Cells small, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells pyramidate, more or less three-lobed; polar lobe short and very broad, oblong-rectangular, lateral margins retuse, apical angles furnished with a short divergent spine, apex truncate, with four undulations and a narrow median incision; lateral lobes bilobulate, both upper and lower lobules truncato-emarginate; semicells with a small tumour in the centre ornamented with a ring of granules. Cell-wall furnished with a number of granules within the polar and lateral lobes. Side view of semicell ovate pyramidate, apex acute, with a truncate granulate protuberance near the base on each side. Vertical view elliptic,

poles acutely rounded, with a truncate granulate protuberance at the middle on each side.

Zygospore unknown.

Length 39–50 μ; breadth 28–33 μ; breadth across polar lobe 20–23 μ; breadth of isthmus 7–9 μ; thickness 18–20 μ.

England.—Hampsfell, Lancashire!

Scotland.—Rhiconich, Sutherland! Aboyne, Aberdeen!

Ireland. — Near Glenties and Lough Nacally, Donegal! Derryclare Lough, Galway!

Geogr. Distribution.—Australia.

This species differs from *E. denticulatum* (Kirchn.) Gay in its larger size, in the form of the polar lobe, and in the bilobulate condition of the lateral lobes.

23. **Euastrum spinosum** Ralfs.

(Pl. XXXVII, figs. 14, 15.)

Euastrum spinosum Ralfs in Ann. Mag. Nat. Hist. 1844, xiv, p. 192, t. 7, f. 6; Hass. Brit. Freshw. Alg. 1845, p. 384, t. 91, f. 9.

E. elegans (Bréb.) Kütz. var. *spinosum* Ralfs, Brit. Desm. 1848, p. 89, t. 14, f. 7 *f–l*; Rabenh. Flor. Europ. Algar. III, 1868, p. 185; Kirchn. Alg. Schles. 1878, p. 159; Cooke, Brit. Desm. 1886, p. 74, t. 35, f. 5; Hansg. Prodr. Algenfl. Böhm. 1888, p. 252; West & G. S. West, Some N. Amer. Desm. 1896, p. 244, t. 14, f. 27.

Cells small, almost $1\frac{3}{4}$ times longer than broad, deeply constricted, sinus narrowly linear; semicells pyramidate, with convex sides which are gently sinuate, bearing one or two denticulations on the basal sinuation, and a short, upwardly-directed spine on each of the other two sinuations, apex rounded-truncate, with a rather deep and narrow median incision; semicells with a quadriverrucose protuberance in the middle above the isthmus, a wart-like granule on each side of the apical incision, and a number of small granules or fine denticulations within the marginal sinuations and at the apex. Side view of semicell ovate-pyramidate, apex rounded, with a small emarginate protuberance at the base on each side, lateral margins undulate.

Vertical view elliptic, with pointed and denticulate poles, lateral margins granulate or denticulate, and with a broad emarginate protuberance at the middle on each side.

Zygospore globose, furnished with numerous, rather bluntly-pointed spines.

Length 28–38·5 μ; breadth 18–23 μ; breadth of isthmus 5·5–6·5 μ; thickness 12·5–13·5 μ; diam. zygosp. without spines 26–30 μ; length of spines 7·5–9·6 μ.

England.—Cornwall (*Ralfs*).

Wales.—Dolgelly (*Ralfs*).

Ireland.—Dublin and Wicklow (*Archer*).

Geogr. Distribution.—Germany. Sweden. India. United States. Guiana.

We think *E. spinosum* Ralfs possesses sufficiently distinctive characters to allow of its remaining as a distinct species. The gently-sinuate margins of the semicells, the absence of any trace of a "neck," and the spines on the lateral margins, distinguish it from ordinary forms of *E. elegans*. Ralfs also states that the zygospore possesses more slender and more numerous spines than that of *E. elegans*.

The *Euastra* figured by Wolle, 'Desm. U. S.' t. 27, figs. 4–7, as "*E. spinosum*" do not belong to this species.

24. **Euastrum bidentatum** Näg.

(Pl. XXXVII, figs. 16–19.)

Euastrum bidentatum Näg. Gatt. einzell. Alg. 1849, p. 122, t. 7 D, f. 1 *a-f*; West & G. S. West, Alga-fl. Yorks. 1900, p. 62; Alg. N. Ireland, 1902, p. 29.

E. elegans (Bréb.) Kütz. var. *bidentatum* (Näg.) Jacobs. Desm. Danem. 1875, p. 191; Börg. Bornholm. Desm.-fl. 1889, p. 143, t. 6, f. 2; Borge, Chlorophy. Norska Finmark. 1892, p. 6; Roy & Biss. Scott. Desm. 1893, p. 176; Börg. Ferskv. alg. Östgrönl. 1894, p. 31; West & G. S. West, Alg. S. England, 1897, p. 483.

E. elegans (Bréb.) Kütz. var. *speciosum* Boldt, Desmid. Grönland, 1888, p. 9, t. 1, f. 10, 11; De Toni, Syll. Alg. 1889, p. 1102; Schmidle, Beitr. alp. Alg. 1895, p. 22.

Cells small, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells subpyramidate, with bilobulate

sides; lower lobule subrectangular, sometimes emarginate, and furnished with two or three sharp granules; upper lobule rounded or rounded-truncate, rarely emarginate, sometimes furnished with one or with two sharp granules; apex convex, sometimes slightly undulate, with a deep median notch, which may be somewhat open or closed, with a short, blunt spine at each apical angle, and usually with a thickening at the angles on each side of the apical incision; semicells with a granulated protuberance in the centre above the isthmus (number and disposition of granules variable), with a large granule below and on each side of the apical incision (sometimes absent), and with a few variously-disposed granules within the lateral lobules and the apex. Side view of semicell ovate, with a protuberance (usually emarginate) on each side near the base, and a granule on each side higher up on the lateral margins; apex rounded and tridenticulate. Vertical view elliptic, with a protuberance (emarginate or trigranulate) at the middle on each side, poles furnished with acute granules or denticulations.

Zygospore globose, furnished with numerous strong simple spines, most of which are curved.

Length 51–61 μ; breadth 32–39 μ; breadth of apex 25–29 μ; breadth of isthmus 6·3–11 μ; thickness 21–23 μ; diam. of zygosp. without spines 40–42·5 μ; length of spines 10–13 μ.

England. — Westmoreland! N. and W. Yorks! Lancashire! Essex! Oxfordshire! Surrey! Kent! Hants. (zygospores from the New Forest)! Devon! Cornwall!

Wales.—General throughout Carnarvonshire (at 2,200 ft. on Glyder Fach)!

Scotland. — Common! (*Roy & Bissett*). Outer Hebrides! Orkneys! Shetlands!

Ireland.—General!

Geogr. Distribution.—Germany. Norway. Sweden. Denmark. Bornholm. Iceland. Greenland. Russia. United States. Brazil.

E. bidentatum Näg. is a species well differentiated from *E. elegans* by its lobulate margins, its larger and more depressed apices, and its ornamentation. It is also larger than most forms of *E. elegans*, although it is connected with that species by *E. elegans* var. *Novæ Semliæ* and *E. elegans* var. *ornatum*.

It is generally distributed all over the British Islands, and retains its distinctive characters in a very constant manner. Almost the only variation met with is in the form of the lateral lobules and in the disposition of the surface ornamentation. The central protuberance varies much in the number and arrangement of its granules. The figures given by Nägeli are fairly good in outline, but he does not indicate the markings which are always present on this species.

Most probably the figure of *E. elegans* in Ralfs' 'Brit. Desm.,' t. 14, f. 7*a*, is a form of this species.

25. **Euastrum pictum** Börg.

(Pl. XXXVIII, fig. 1.)

Euastrum pictum Börg. Desm. Brasil. 1890, p. 34, t. 3, f. 19.

Cells relatively small, a little more than $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells subquadrate, three-lobed; polar lobe short and much dilated, apex convex and undulate, with an open median incision, apical angles furnished with a short, strong spine; lateral lobes bilobulate, upper lobule small and furnished with two small teeth, lower lobule larger and furnished with three small teeth; semicells in centre with a large granulate protuberance, and with smaller granulate protuberances within each lateral lobule and each half of the polar lobe. Vertical view elliptic, poles denticulate, and with a median granulated protuberance on each side.

Zygospore unknown.

Length 72 μ; breadth 43 μ; breadth of isthmus, 11 μ; thickness, 27 μ.

Geogr. Distribution.—Brazil. United States (var).

Absolutely typical forms of *E. pictum* do not occur in the British Isles. Those already recorded (consult West, 'Alg.

W. Ireland,' 1892, p. 139), and others that we have seen, bear a striking resemblance to large forms of *E. bidentatum* Näg. They differ from *E. pictum* in having the lateral teeth reduced to acute granules, and in the replacement of the special, granulated protuberances by single large granules. They would be almost equally well placed under *E. bidentatum*, except for their size and additional protuberances.

Length 79 μ; breadth 52 μ; breadth of isthmus 14 μ. (Pl. 38, fig. 2.)

Wales.—Moel Siabod and Llyn Ogwen, Carnarvonshire!

Scotland.—Rhiconich, Sutherland!

Ireland.—Lakes near Recess, Oorid and Arderry Loughs, Galway! Glen Caragh, Lough Guitane, Castletown and Carrantuohill, Kerry!

26. **Euastrum divaricatum** Lund.

(Pl. XXXVIII, figs. 3, 4.)

Euastrum divaricatum Lund. Desm. Suec. 1871, p. 21, t. 2, f. 5; ? Wolle, Desm. U. S. 1884, p. 104, t. 26, f. 18–19; De Toni, Syll. Alg. 1899, p. 1100; Turner, Freshw. Alg. E. India, 1893, p. 84, t. 11, f. 22; Eichler, Mat. flor. Meidz. 1894, p. 130.

Helierella divaricata Kuntze, Revis. gen. plant. 1891, p. 898.

Cells small, $1\frac{1}{4}$ times longer than broad, very deeply constricted, sinus narrowly linear with a dilated extremity; semicells subtriangular, rapidly attenuated to the convexo-truncate apex, more or less three-lobed; polar lobe very broad, rectangular-oblong, each apical angle furnished with a small spine, median incision deep and open; lateral lobes bilobulate, upper lobules widely triangular and rounded, lower lobules truncate-rounded, furnished with a denticulation at the entrance to the sinus and with a horizontal or upwardly-diverging spine; semicells with a protuberance in the middle above the isthmus, biverrucose, triverrucose, or granulate, with a large rounded granule on each side of the apical incision at the base of the polar lobe, and with about four granules within the lateral margins and two within the apex. Side view of semicell ovate, apex furnished with a small spine, and with a granulate or emarginate protuberance at each side near the base.

Vertical view elliptic, with a spine at each pole, and a granulate or emarginate protuberance at the middle on each side.

Zygospore unknown.

Length 36–45 μ; breadth 31–36 μ; breadth of isthmus 6–7 μ; thickness 16–19 μ.

Scotland.—Glen Coe, Argyll (*Roy and Bissett*). Loch Iron Sineur, Perth! (*J. Murray*). Rhiconich, Sutherland!

Geogr. Distribution.—Austria and Galicia. Norway. Sweden. Denmark. Poland. N. Russia. India (var.). United States. West Indies and Brazil (var.).

This is a very rare species in the British Islands and has essentially a western distribution.

27. **Euastrum dubium** Näg.

(Pl. XXXVIII, figs. 5–8.)

Euastrum binale Ralfs, Brit. Desm. 1848, t. 14, f. 7 *d*.
E. dubium Näg. Gatt. eing. Alg. 1849, p. 122, t. 7 D, f. 2; Nordst. Index Desm. 1896, p. 113.
E. lobulatum Bréb. Liste Desm. 1856, p. 124, t. 1, f. 4; West & G. S. West Alg. Notes II, 1900, p. 290; Alga-fl. Yorks. 1900, p. 63; Alg. N. Ireland, 1902, p. 29.
E. elegans (Bréb.) Kütz. var. *lobulatum* (Bréb.) Jacobs. Desm. Danem. 1875, p. 191.
E. binale (Turp.) Ehrenb. var. *rotundata* Istvanffi, Diag. præv. Alg. nov. Hungar. 1887, p. 236 (according to Istvanffi).
E. erosum Lund. var. *notabile* West, Alg. Eng. Lake Distr. 1892, p. 723, t. 9, f. 17; West & G. S. West, Alg. S. England, 1897, p. 484.

Cells very small, 1½ times longer than broad, very deeply constricted, sinus narrowly linear with a slightly-dilated extremity; semicells truncato-pyramidate, five-lobed; polar lobe short, oblong-rectangular, apex truncate with a narrow median incision, apical angles furnished with a small conical granule; upper lateral lobes rounded; lower lateral lobes very slightly larger than the upper ones, rounded, obliquely truncate, or sometimes slightly emarginate; semicells with two granules within the apex, one on each side of the notch, with two faint granules within each basal angle, often with a faint granule below the apical notch, and with a slight trace of a smooth central protuberance.

Side view of semicell ovate-oblong, apex acutely rounded, very slightly dilated on each side at the base. Vertical view elliptic-oblong, poles acute, and with a very slight swelling (sometimes absent) at the middle on each side.

Zygospore unknown.

Length 26·5–33 μ; breadth 19–21 μ; breadth of isthmus 4–6 μ; thickness 10–12·5 μ.

England.—Westmoreland! N., W., and E. Yorks! Lancashire! Lincolnshire! Essex! Wilts! Surrey! Devon! Cornwall!

Wales.—Bogs above Capel Curig, Glyder Fach at 2,200 ft., near Llyn Idwal, Y Foel Fras, and Rhyddu, Carnarvonshire!

Scotland.—General! (*Roy & Bissett*). Up to 3,500 ft. on Lochnagar, Aberdeenshire! Common in the Outer Hebrides! Orkneys! Shetlands!

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Down!

Geogr. Distribution. — France. Norway. Sweden. Denmark. Italy.

We gave full reasons for considering *Euastrum erosum* var. *notabile* as identical with *E. lobulatum* Bréb. in the 'Journal of Botany,' 1900, p. 290, and in the 'Alga-flora of Yorkshire,' p. 63. We also think that *E. lobulatum* is correctly identified with Nägeli's *E. dubium*, which was described seven years previously. Nägeli's figures are not good, but there can be no question that they represent the same plant as that described and figured by Brébisson under the name of *E. lobulatum*.

It is a widely distributed species and is found in the boggy districts of every part of the British Islands.

It is easily distinguished from *E. binale* by its relatively greater length, its equal lobulation at the sides, and by the markings on the semicells.

Var. **anglicanum** (Turn.) *nob.* (Pl. XXXVIII, fig. 9.)

Euastrum anglicanum Turn. Desm. Notes, 1893, p. 343, fig. 6.

Apex of semicells convexo-truncate, apical incision open; with a few scattered granules within the lateral

lobes, and with five granules arranged on a central protuberance.

Length 36 μ; breadth 22 μ; breadth of isthmus 6 μ.

England.—Trelleck Common, Monmouth (*Turner*).

Var. **cambrense** (Turn.) *nob.* (Pl. XXXVIII, fig. 10.)

Euastrum cambrense Turn. Desm. Notes, 1893, p. 343, f. 1.

Upper lateral lobes furnished with a short, upwardly-directed spine; with six granules forming a ring on the central protuberance.

Length 32 μ; breadth 20 μ; breadth of isthmus 5 μ; thickness 9·5 μ.

Wales. — Near Dolbadarn Castle, Carnarvonshire (*Turner*).

Var. **Snowdoniense** (Turn.) *nob.* (Pl. XXXVIII, fig. 11.)

Euastrum Snowdoniense Turn. Desm. Notes, 1893, p. 343, f. 2.

Cell-wall of lateral lobes and polar lobe thickened at the margin; apical notch open; with three small protuberances (?) forming a triangle in the centre of the semicell.

Length 31 μ; breadth 20 μ; breadth of isthmus 6·5 μ.

Wales.—Snowdon, Carnarvonshire (*Turner*).

28. **Euastrum erosum** Lund.

(Pl. XXXVIII, figs. 12, 13.)

Euastrum erosum Lund. Desm. Suec. 1871, p. 22, t. 2, f. 6; Cohn, Desm. Bongo. 1879, t. 11, f. 12; Cooke, Brit. Desm. 1886, p. 77, t. 35, f. 12; De Toni, Syll. Alg. 1889, p. 1072; West, Alg. aq. dulc. Lusitan. 1892, p. 1501; Roy & Biss. Scott. Desm. 1893, p. 176; Nordst. Index Desm. 1896, p. 119; West & G. S. West, Alga-fl. Yorks. 1900, p. 63.
Helierella erosa Kuntze, Revis. gen. plant. 1891, p. 898.

Cells very small, $1\frac{1}{2}$–$1\frac{3}{4}$ times longer than broad, deeply constricted, sinus narrowly linear; semicells somewhat hexagonal, the base broader than the remaining sides, angles rounded, lower portions of lateral margins parallel and retuse, upper portions converging

towards the apex, and retuse, apex truncate and retuso-emarginate. Side view of semicell quadrate-rectangular, with attenuated poles which are 3-*crenulate*. Vertical view subrectangular, with slightly convex sides, poles broadly truncate and 3-*crenulate*. Cell-wall smooth.

Zygospore unknown.

Length 32–39 μ; breadth 20–23 μ; breadth of isthmus 7·5–8·5 μ; thickness 11–16 μ.

England. — Westmoreland (*Bissett*). Mickle Fell, N. Yorks! Hants, Devon, and Cornwall (*Bennett*).

Wales.—Capel Curig and Pen-y-gwrydd, Carnarvonshire (*Roy*).

Scotland.—Ross, Inverness!, Aberdeen, Kincardine, Forfar, Perth, Argyll and Arran (*Roy & Bissett*).

Ireland.—Dublin and Wicklow (*Archer*).

Geogr. Distribution.—Germany. Portugal. Norway. Sweden. India (form). Central Africa. United States.

E. erosum differs from *E. dubium* in the character from which the species derives its name, viz., the crenulated poles of the side and vertical views. It is also less lobed, with a less deep apical incision, and is completely destitute of any granulation on the surface.

29. **Euastrum pulchellum** Bréb.

(Pl. XXXVIII, figs. 14, 15.)

Euastrum pulchellum Bréb. Liste Desm., 1856, p. 124, t. 1, f. 5; Arch. in Pritch. Infus., 1861, p. 730; Rabenh. Flor. Europ. Algar. III, 1868, p. 186; De Toni, Syll. Alg. 1889, p. 1106; Roy. & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 211; West & G. S. West, Alga-fl. Yorks, 1900, p. 63; Alg. N. Ireland, 1902, p. 29.
Helierella pulchella Kuntze, Revis. gen. plant. 1891, p. 899.

Cells small, about $1\frac{1}{3}$ times longer than broad, very deeply constricted, sinus narrowly linear with a slightly-dilated extremity; semicells more or less three-lobed, with a shallow sinus between the lobes; polar lobe widely rectangular-oblong, apex truncate with a deep and narrow median incision, apical angles furnished with a short diverging spine; lateral lobes rounded

quadrate, ornamented with 6–8 acute granules (3–4 marginal); semicells with a triverrucose protuberance in the centre above the isthmus, a large rounded granule on each side of the apical incision, and often a small granule at each angle of the apical incision. Side view of semicell ovate-oblong, with an emarginate protuberance at each side near the base, and a rounded granule at each side near the apex, apex rounded and furnished with a spine. Vertical view oblong, with rounded denticulate poles, and an emarginate protuberance in the middle on each side.

Zygospore unknown.

Length 37–40 μ; breadth 28–33 μ; breadth of isthmus 7–8 μ; thickness 19–20 μ.

England.—Bowness, Westmoreland! Riccall Common, E. Yorks! New Forest, Hants! Tremethick Moor, Cornwall!

Scotland.—Sutherland!, Ross, Aberdeen, Kincardine, Forfar, Perth, Argyll (*Roy & Bissett*). Harris and Lewis, Outer Hebrides!

Ireland.—Dungloe, Loughs Gartan and Machugh, Sproule's Lough, Donegal! Lough Derryclare and Oughterard, Galway!

Geogr. distribution.—France.

Brébisson's figure of *E. pulchellum* is a very poor one and is inaccurate in its details. We find the species scarce but widely distributed in the British Islands.

Perhaps the figure given by Wolle, 'Desm. U. S.' t. 27, f. 9, of *E. rostratum* belongs to this species.

Var. **retusum** *nov. var.* (Pl. LXIV, fig. 17.)

Lateral lobes less protuberant, broader, and slightly retuse on their outer margin, with the upper angles emarginate; polar lobe with a convex apex and with the median notch widely open.

Length 40 μ; breadth 26 μ; breadth of isthmus 7·5 μ.

England.—Bowness, Westmoreland!

30. **Euastrum elegans** (Bréb.) Kütz.

(Pl. XXXVIII, figs. 16–21.)

Heterocarpella elegans Bréb. in Cheval. microscop. et usage, Paris, 1839, p. 72 (name only).
Cosmarium elegans Bréb. in Menegh. Synops. Desm. 1840, p. 222.
Euastrum elegans (Bréb.) Kütz. Phycol. germ. 1845, p. 135; Ralfs, Brit. Desm. 1848, p. 89, t. 14, f. 7 *b*, *c*, and *d*; Arch. in Pritch. Infus. 1861, p. 730; Rabenh. Flor. Europ. Algar III, 1868, p. 185; Cooke Brit. Desm. 1886, p. 74, t. 35, f. 3; De Toni, Syll. Alg. 1889, p. 1101; West, Alg. W. Ireland, 1892, p. 139; Roy. & Biss. Scott. Desm. 1893, p. 176; Nordst. Index Desm. 1896, p. 116; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 63; Alg. N. Ireland, 1902, p. 28; Scott. Freshw. Plankton, I, 1903, p. 525.
E. elegans from *declivis* Reinsch, Spec. Gen. Alg. 1867, p. 124, t. 20, f. D III 1–3.
Didymidium (*Euastrum*) *elegans* Reinsch, Algenfl. Frank. 1867, p. 136.
Euastrum elegans a. *typicum* Kirchn. Alg. Schles. 1878, p. 159.
E. declive Roy in Bates' Flora Leicestershire, 1886, p. 35.
E. elegans var. *Lundellii* Istvanffi, Diag. præv. Alg. nov. Hungar. 1887, p. 236 (Ralfs l.c. fig. 7 *b* and *c*).
Helierella elegans Kuntze, Revis. gen. plant. 1891, p. 898.

Cells very small, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear; semicells ovate-pyramidate, basal angles subrectangular, retuse-emarginate, above with the sides concave, superior angles apiculate, apex strongly convex (or broadly rounded) with a deep and narrow median incision; semicells with a triverrucose or a granulate protuberance in the centre above the isthmus, the rest of the cell-wall generally smooth. Side view of semicell ovate, with a truncately-rounded apex, and an emarginate protuberance on each side above the base. Vertical view elliptic, with acute poles, and an emarginate protuberance in the middle on each side.

Zygospore globose, furnished with simple acute spines.

Length 29–36·5 μ; breadth 19–22 μ; breadth of isthmus 5·8–7 μ; thickness 10–14·5 μ; diam. of zygosp. without spines 20–29 μ; length of spines 7·5–9·5 μ.

England.—Cumberland ! Westmoreland ! (*Ralfs*). W., N., and E. Yorks ! Lancashire ! Cheshire (*Ralfs*). Leicestershire (*Roy*). Essex ! Warwick (*Wills*). Gloucestershire (*Ralfs*). Surrey ! (*Ralfs*). Sussex

(*Ralfs*). Kent! Hants (zygospores from New Forest)! (*Ralfs*). Devon! Cornwall! (*Ralfs*).

Wales.—Generally distributed!

Scotland.—Generally distributed! zygospores at Slewdrum, Aberdeen (*Roy & Bissett*). Outer Hebrides! Orkneys! Shetlands!

Ireland.—Common.

Geogr. distribution.—France. Germany. Galicia and Austria. Hungary. Sicily. Norway. Sweden. Denmark. Bornholm. Finland. N., Central, and S. Russia. Faeroes. Nova Zembla. Spitzbergen. Greenland. Siberia. Japan. India (var.). New Zealand (var.) Madagascar (var.). E. and Central Africa. Azores. United States. West Indies. Brazil. Argentina.

E. elegans is one of the most widely-distributed British species of the genus. It can always be recognised by its broadly-rounded apices with a deep median incision, and by the truncate-retuse basal angles. It is a small smooth species with a well-marked central protuberance, which is usually split into three warts.

The zygospore occurs frequently and is covered with simple, blunt spines.

Var. **pseudelegans** (Turn.) *nob.* (Pl. XXXVIII, figs. 22, 23.)

Euastrum pseudelegans Turn. New and Rare Desm. 1885, p. 935, t. 15, f. 8; De Toni, Syll. Alg. 1889, p. 1102; West, Alg. N. Wales, 1890, p. 287.
Helierella pseudelegans Kuntze, Revis. gen. plant, 1891, p. 899.

Basal angles of semicells broadly rounded, with a number of depressed granules within the margins and near the centre of the semicells.

Length 40 μ; breadth 25·5 μ; breadth of isthmus 7 μ.

Wales.—Capel Curig, Carnarvonshire.

Geogr. Distribution.—United States.

Var. **Novæ Semliæ** Wille. (Pl. XXXVIII, figs. 24, 25.)

E. elegans subsp. *Novæ Semliæ* Wille, Ferskv. Alg. Nov. Semlj. 1879, p. 32, t. 12, f. 8.

Cells slightly larger than in the type; semicells with

obliquely-truncate or acutely-rounded basal angles, and with an undulation between the basal angle and the upper apiculation; central protuberance triverrucose or granulate; semicells sometimes with a few granules within the marginal undulations.

Length 36·5–53 μ; breadth 22·5–34 μ; breadth of isthmus 3·8–9 μ; thickness 15–24 μ.

Scotland.—Near Tarbert, Harris, Outer Hebrides!

Ireland.—Slieve Donard, Down!

Geogr. Distribution.—Nova Zembla.

Var. **ornatum** West. (Pl. XXXVIII, fig. 26.)

E. elegans var. *ornatum* West, Alg. Engl. Lake Distr. 1892, p. 723, t. 9, f. 9; West & G. S. West, Some N. Amer. Desm. 1896, p. 244.

Cells slightly larger than in the type; basal angles furnished with a granule and also with one just within the margin, with an undulation between the base and the upper apiculation on each lateral margin; with six large rounded granules in the centre of the semicells near the base (in 2 series of 3) and with one on each side of the apical incision.

Length 45–47 μ; breadth 28–29 μ; breadth of isthmus 8–10 μ; thickness 14–17·5 μ.

England.—Harrop Tarn, Cumberland! Stickle Tarn and Bowness, Westmoreland!

Wales.—Glyder Fach, Carnarvonshire!

Scotland.—Glen Shee, Perthshire!

Geogr. Distribution.—United States.

This is a very characteristic variety differing materially from other forms of *E. elegans* in the six central granules.

Var. **ornithocephalum** (Benn.) *nob.* (Pl. XXXVIII, fig. 27.)

E. ornithocephalum Benn. Freshw. Alg. Eng. Lake Distr. 1886, p. 9, t. 1, f. 12; Cooke, Brit. Desm. 1886, p. 78, t. 35 (after Bennett); De Toni, Syll. Alg. 1889, p. 1107; Benn. Freshw. Alg. Hamps. and Devon, 1890, p. 7.

Helierella ornithocephala Kuntze, Revis. gen. plant. 1891, p. 899.

Cells somewhat larger than in the type: almost twice as long as broad, basal angles rounded and

laterally expanded, with an undulation between the base and the upper apiculation on each side.

Length 57 μ; breadth 30 μ.

England. — Loughrigg, Westmoreland (*Bennett*). New Forest, Hants (*Bennett*).

31. **Euastrum binale** (Turp.) Ehrenb.
(Pl. XXXVIII, figs. 28, 29.)

Heterocarpella binalis Turp., 1820; Aperçu organograph. 1828, p. 315, t. 13, f. 17 (figure bad); Kütz. Syn. Diat. 1834, p. 598.
Cosmarium binale (Turp.) Menegh. Synops. Desm. 1840, p. 221.
Euastrum binale (Turp.) Ehrenb. Berlin. Monatsber. 1840, p. 208; Hass. Brit. Freshw. Alg. 1845, p. 384, t. 91, f. 4–5; Ralfs, Brit. Desm. 1848, p. 90, t. 14, f. 8 *b*, *e*, and *h*; Arch. in Pritch. Infus. 1861, p. 730; Rabenh. Flor. Europ. Algar. III, 1868, p. 186; Lund. Desm. Suec. 1871, p. 22, 23; Delp. Desm. subalp. 1873, p. 107, t. 6, f. 9–10; ? Wolle, Desm. U. S. 1884, p. 107, t. 27, f. 23, 24; Cooke, Brit. Desm. p. 75, t. 35, f. 6 *a–d*; Hansg. Prodr. Algenfl. Böhm. 1888, p. 207, 252; West, Alg. W. Ireland, 1892, p. 139; Alg. Eng. Lake Distr. 1892, p. 723; Roy & Biss. Scott. Desm. 1883, p. 176; Nordst. Index Desm. 1896, p. 59; West & G. S. West, Alg. S. England, 1897, p. 484; Alga-fl. Yorks. 1900, p. 64; Alg. N. Ireland, 1902, p. 29.
Didymidium (*Euastrum*) *binale* Reinsch, Algenfl. Frank. 1867, p. 138.
Euastrum binale a. *typicum* Kirchn. Alg. Schles. 1878, p. 159.
Helierella binalis Kuntze, Revis. gen. plant. 1891, p. 898.
Euastrum binale forma a. *minuta* Turn. Freshw. Alg. E. India, 1893, p. 81 t. 10, f. 50 (Ralfs l.c. f. 8 *e*).
E. binale forma b. *ventricosa* Turn. l.c. p. 81 (Ralfs, l.c. f. 8 *b*).

Cells minute, about $1\frac{1}{3}$ times longer than broad, deeply constricted, sinus narrowly linear; semicells subpyramidate, basal angles broadly rounded, entire, upper part of lateral margins concave; apex broad and truncate, retuso-emarginate in the middle, upper angles dilated to form a minute apiculus. Side view of semicell ovate, apex acutely rounded, with a slight protuberance near the base on each side. Vertical view elliptic, poles acute, with a small, rounded protuberance at the middle on each side. Cell-wall smooth.

Zygospore globose, furnished with simple, somewhat blunt spines.

Length 15–30 μ; breadth 12·5–21 μ; breadth of isthmus 3–8·5 μ; thickness 9–13 μ; diam. zygosp. without spines 20–26 μ; length of spines 5–7 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W., N., and E. Yorks (zygospores from Widdale Fell,

N. Yorks)! Lancashire! Cheshire (*Roy*). Leicestershire (*Roy*). Warwick (*Wills*). Gloucester (*Ralfs*). Surrey! (*Ralfs*). Sussex (*Ralfs*). Hants! (*Ralfs*). Devon! Cornwall! (*Ralfs*).

Wales.—General and abundant (up to 2,700 ft. on Glyder Fawr, Carnarvonshire)!

Scotland.—General and abundant! (*Roy & Bissett*). Up to 3,500 ft. on Lochnagar! Outer Hebrides! Orkneys! Shetlands!

Ireland.—Abundant!

Geogr. Distribution.—France. Germany. Galicia and Austria. Hungary. Italy. Portugal. Norway. Sweden. Denmark. Bornholm. Finland. N. and S. Russia. Faeroes. Iceland. Nova Zembla. Spitzbergen. Greenland. Siberia. India. Ceylon. Siam. Singapore. Australia. New Zealand. Madagascar. Central and E. Africa. Sandwich Islands. United States. W. Indies. Brazil. Patagonia.

E. binale is generally distributed all over the British Islands, and numerous varieties of it exist. *The semicells of the type-form possess rounded and entire basal angles, and the apex is truncate and slightly retuse-emarginate in the middle.* Forms of *E. binale* should never be confused with forms of *E. elegans* on account of the very different apices. In *E. elegans* the apex is broadly rounded with a deep median incision, but in *E. binale* the apex is truncate and retuse in the middle.

Forma **minor** West.

E. binale forma *minor* West, Desm. Maine, 1888, p. 340; Desm. Mass. 1889, p. 19, t. 3, f. 24; Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 140; West & G. S. West, Alg. S. England, p. 484.

Cells very minute, about half the average size of the type.

Length 10–12 μ; breadth 7·5–11 (rarely to 12) μ.

England.—Adel Bog, W. Yorks, and Pilmoor, N. Yorks! Puttenham Common, Surrey!

Wales.—Capel Curig, Carnarvonshire! Ffestiniog, Merioneth!

Ireland.—Not uncommon!

Geogr. Distribution.—United States.

Forma **secta** Turn. (Pl. XXXVIII, fig. 30.)

E. binale forma d. *secta* Turn. Freshw. Alg. E. India, 1893, p. 81, t. 10, f. 35, 39, 47; t. 11, f. 5. [= *E. binale* forma c. lobis basalibus sinuato-bilobulatis Lund. Desm. Suec. 1871, p. 23; *E. binale* Ralfs, l.c. t. 14, f. 8c.]

Basal angles of semicells truncato-retuse (or sinuato-bilobulate).

Length 20–28 μ; breadth 16–21 μ; breadth of isthmus 6–8 μ.

England.—Westmoreland! W. and N. Yorks! Lancashire! Surrey! Hants! Devon! Cornwall!

Wales.—Capel Curig and Llyn-y-cwm-ffynon, Carnarvonshire!

Scotland.—General! (*Roy & Bissett*).

Ireland.—General, but scarce!

Geogr. Distribution.—Norway. Sweden. India.

Forma **hians** West. (Pl. XXXVIII, fig. 33.)

E. binale forma *hians* West, Alg. W. Ireland, 1892, p. 140, t. 20, f. 14 West & G. S. West, Obs. on Conj. 1898, t. 4, f. 38; Alga-fl. Yorks. 1900, p. 64.

Basal angles of semicells subacute, obliquely truncate towards the sinus.

Length 11–16 μ; breadth 10–12·5 μ; breadth of isthmus 2·5–3·5 μ; thickness 6–7 μ.

England.—Near Cockley Beck, Lancashire! Keighley Moor, W. Yorks! Skipwith Common, E. Yorks! Dartmoor, Devon!

Ireland.—Ballynahinch and Lakes near Recess, Galway! Near Foxford, Mayo!

Geogr. Distribution.—Germany. Ceylon.

Forma **Gutwinskii** Schmidle. (Pl. XXXVIII, figs. 31, 32.)

E. binale forma, Gutw. Flor. Glon. Okolic Lwowa, 1891, p. 73, t. 3, f. 25.
E. binale forma *Gutwinskii* Schmidle, Alg. Geb. Oberrheins, 1894, p. 552; Lappmark Süsswasseralgen, 1898, p. 44.
E. binale forma, Schmidle, Beitr. Algenfl. Rheineb. u. Schwarzwald. 1895, p. 79, t. 1, f. 13, 14.

Basal angles of semicells triundulate or slightly tricrenate.

Length 22–29 μ; breadth 14–20 μ; breadth of isthmus 4·8–5·5 μ; thickness 11–12 μ; diam. zygosp. without spines 27–29 μ; length of spines 3·8–9·5 μ.

England.— Helvellyn, Westmoreland! Mossdale Moor, Widdale Fell, N. Yorks (with zygospores)!

Scotland.—Moidart, Inverness! Rhiconich, Sutherland! Near Kirkwall, and Hoy, Orkneys!

Wales.—Bog below Llyn Idwal, Carnarvonshire!

Ireland.—Near Foxford, Mayo!

Geogr. Distribution.—Germany. Galicia in Austria. Lappmark in Sweden.

Var. **retusum** West. (Pl. XXXVIII, fig. 34.)

E. binale var. *retusum* West, Alg. Engl. Lake Distr. 1892, p. 723, t. 9, f. 6.

Basal angles of semicells obliquely truncate-retuse; apex broadly truncate-retuse; cell-wall finely granulate-punctate; central protuberance broadly rounded and granulate.

Length 27 μ; breadth 21 μ; breadth of isthmus 8 μ; thickness 12 μ.

England.—Kirk Fell, Westmoreland!

Var. **elobatum** Lund. (Pl. XXXVIII, fig. 35.)

E. binale var. *elobatum* Lund. Desm. Suec. 1871, p. 23, t. 2, f. 7; Cooke, Brit. Desm. 1886, p. 75, t. 35, f. 8; Lütkem. Desm. Attersees, 1893, p. 559; West & G. S. West, Alg. S. England, 1897, p. 484; Alga-fl. Yorks. 1900, p. 64; Alg. N. Ireland, 1902, p. 29.
E. elobatum (Lund.) Roy & Biss. Scott. Desm. 1893, p. 176.

Cells hexagonal; semicells pyramidate, apices as in type, lateral margins with a median undulation between the base and the apex.

Length 21–28 μ; breadth 15·5–20·5 μ; breadth of isthmus 4–5 μ; thickness 11 μ.

England.—Bassenthwaite Water and Borrowdale, Cumberland! Helvellyn and Brothers Water, Westmoreland! Penyghent, W. Yorks! Strensall Common, Mickle and Cronkley Fells, N. Yorks! Riccall Common,

E. Yorks! Near Cockley Beck, Lancashire! Esher West-end Common, Surrey!

Wales.—Bethesda, Capel Curig, and Snowdon, Carnarvonshire! Ffestiniog and Dolgelly, Merioneth!

Scotland.—Loch Inver, Sutherland; Poolewe, Ross; near Alford, Ballater and Aboyne, Aberdeen (*Roy & Bissett*). Ben Chiurn, Glas Maol, and Craigan Lochan, Perth!

Ireland.—Dungloe, Lough Nacung and Glentornan, Donegal! Ballynahinch and Derryclare Lough, Galway!

Geogr. Distribution.—Austria. Norway. Sweden. Poland. United States.

Note.—Euastrum Lundellii Benn. Freshw. Alg. Engl. Lake Distr. 1886, p. 9, t. 1, f. 13. (*Helierella Lundellii* Kuntze.) Bennett stated that this plant was the same as *E. binale* var. *elobatum* Lund., but his figure certainly disproves this statement. We have never seen anything approaching Bennett's figure and doubt very much if his plant could have belonged to the genus *Euastrum*.

Var. **subelobatum** West. (Pl. XXXVIII, fig. 36.)

E. binale subsp. *subelobatum* West, Alg. W. Ireland, 1892, p. 140, t. 20, f. 15; West & G. S. West, Alga-fl. Yorks. 1900, p. 64.

Cells somewhat hexagonal; semicells with truncate-emarginate basal angles and an undulation on each lateral margin between these angles and the apex; side view of semicell subrhomboid with rounded angles and undulate sides; vertical view rhomboid-elliptic with rounded angles and undulate sides.

Length 26 μ; breadth 18 μ; breadth of isthmus 5 μ; thickness 12·5 μ.

England.—Oughtershaw Tarn, W. Yorks! Baugh Fell, Cronkley Fell, and Craydale Moor, N. Yorks!

Ireland.—Lough Aunierin, Galway! Lough Guitane, Kerry.

This variety is at once distinguished from var. *elobatum* by the truncate-emarginate basal angles of the semicells. The side and vertical views also differ in outline. It is a very uncommon variety, but perhaps it has been overlooked.

32. **Euastrum denticulatum** (Kirchn.) Gay.
(Pl. XXXIX, figs. 1–4.)

Euastrum binale var. β Ralfs, Brit. Desm. 1848, t. 14, f. 8 *a* and *f*.
E. binale b. *denticulatum* Kirchn. Alg. Schles. 1878, p. 159; Cooke, Brit. Desm. 1886, p. 76, t. 35, f. 7; Hansg. Prodr. Algenfl. Böhm. 1888, p. 252.
E. amœnum Gay, Monogr. loc. Conj. 1884, p. 53, t. 1, f. 7.
E. denticulatum (Kirchn.) Gay, Note Conj. du midi de France, 1884, p. 335; West, Alg. W. Ireland, 1892, p. 140; Alg. Eng. Lake Distr. 1892, p. 723; Roy & Biss. Scott. Desm. 1893, p. 176; West & G. S. West, Alg. Madag. 1895, p. 53, t. 9, f. 15, 16; Nordst. Index Desm. 1896, p. 100; West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 84; Alg. S. England, 1897, p. 484; Alga-fl. Yorks. 1900, p. 64; Chlorophy. Koh Chang, 1901, p. 85; Alg. N. Ireland, 1902, p. 29; Scott. Freshw. Plankton, I, 1903, p. 525.
Helierella Kirchneri Kuntze, Revis. gen. plant. 1891, p. 898.

Cells very small but rather variable in size, about $1\frac{1}{4}$ times as long as broad, very deeply constricted, sinus narrowly linear with a dilated extremity; semicells subquadrate or subpyramidate, almost trapezoid, basal angles rounded or subrectangular, furnished with a number of granules or denticulations, upper part of lateral margins concave, apical part of semicell protracted, broadly rectangular, upper angles furnished with an acute granule or short spine, apex truncate with a slight median notch (sometimes only retuse-emarginate); semicells with a granulated central protuberance, and a number of granules or denticulations within the basal angles and the apex. Side view of semicell ovate, with an acute apex, and an emarginate or granulated protuberance at each side near the base. Vertical view elliptic, poles acute, with an emarginate or granulate protuberance at the middle on each side.

Zygospore unknown.

Length 13–26 μ; breadth 11·5–21 μ; breadth of isthmus 3·5–6·5 μ; thickness 7·5–14 μ.

England.—Cumberland! Westmoreland! W., N., and E. Yorks! Lancashire! Surrey! Kent! Hants! (*Roy*). Devon! Cornwall!

Wales.—Frequent through Carnarvonshire (up to 2,200 ft. on Glyder Fach)! Dolgelly, Merioneth!

Scotland.—Generally distributed! (*Roy & Bissett*). General in the Outer Hebrides! Orkneys! Shetlands!

Ireland.—Donegal! Mayo! Galway! Kerry! Down! Armagh! Londonderry!

Geogr. Distribution.—France. Germany. Galicia and Austria. Norway. Sweden. Bornholm. Finland. N. Russia (var.). Iceland. Greenland. Central China. Ceylon. Siam. Singapore. Java. Australia (var.). New Zealand. Madagascar (var.). E. and Central Africa. Azores. United States. West Indies. Brazil (var.).

This species is generally distributed and often abundant. It varies much in size and in the form of the basal angles, but always retains its distinctive features. We have made no attempt to classify the numerous forms which exist.

Var. **granulatum** West. (Pl. XXXIX, fig. 5.)

E. denticulatum var. *granulatum* West, Alg. W. Ireland, 1892, p. 141, t. 20, f. 17.

Superior angles of semicells without an acute tooth; cell-wall finely granulate all over the surface.

Length 18 μ; breadth 18 μ; breadth of isthmus 4 μ; thickness 9 μ.

Ireland.—Ballynahinch, Galway!

33. **Euastrum minutissimum** *nob.*
(Pl. XXXVIII, fig. 37.)

Euastrum exile Turn. Desm. Notes, 1893, p. 346, f. 21 [not *E. exile* Josh. 1886].

Cells very minute, almost twice as long as broad, deeply constricted, sinus narrowly linear; semicells oblong-pyramidate, basal angles rounded, lateral margins retuse, apex rounded, with a median, somewhat open notch. Side view of semicell ovate-pyramidate, apex rounded, lateral margins retuse. Cell-wall smooth.

Zygospore unknown.

Length 15 μ; breadth 8 μ; breadth of isthmus 3 μ; thickness 4 μ.

Wales.—Snowdon, Carnarvonshire (*Turner*).

We have never observed this minute species, but have been

compelled to give it a new name owing to the existence of a Burmese *Euastrum* which was described by Joshua in 1886 as *E. exile*.

34. **Euastrum incavatum** Josh. & Nordst.

(Pl. XXXIX, figs. 6, 7.)

Euastrum incavatum Josh. & Nordst. in Wittr. & Nordst. Alg. Exsic. no. 657, 1884, c. fig. xylogr ; Josh. New and Rare Desm. 1885, p. 33, t. 254, f. 1 ; De Toni, Syll. Alg. 1889, p. 1075 ; West, Alg. N. Yorks. 1889, p. 292 ; West & G. S. West, Alga-fl. Yorks. 1900, p. 65.
Helierella incavata Kuntze, Revis. gen. plant. 1891, p. 898.

Cells small, $1\frac{3}{4}$ times longer than broad, very deeply constricted, sinus narrowly linear; semicells pyramidate from a dilated base, basal angles rounded or somewhat obliquely truncate, gradually attenuated to the apex, which is dilated, upper part of lateral margins retuse, apical angles acute and horizontally subapiculate ; apex convex, suddenly and deeply retuse in the middle ; semicells with a small tubercle within each of the basal and apical angles. Side view of semicell ovate. Vertical view elliptic. Cell-wall smooth.

Zygospore unknown.

Length 35–43 μ; breadth 20–24 μ; breadth of isthmus 4·5–6 μ; thickness 14–16 μ.

England.—Mickle Fell, N. Yorks!

Geogr. Distribution. — United States. W. Indies (Jamaica).

We have only observed this small species on one occasion. It is sharply defined by reason of its relatively great length and its peculiar apex.

35. **Euastrum montanum** West & G. S. West.

(Pl. XXXIX, figs. 8, 9.)

Cosmarium Meneghinii Bréb. forma, Boldt, Desmid. Grönland, 1888, p. 13, t. 1, f. 15.
C. Meneghinii forma *Boldtii* West, Alg. Eng. Lake Distr. 1892, p. 726.
C. Subreinschii Schmidle var. *Boldtiana* Schmidle in Flora, 1894, p. 90, t. 6, f. 8 ; West & G. S. West, Alga-fl. Yorks. 1900, p. 80 ; Alg. N. Ireland, 1902, p. 36.
Euastrum montanum West & G. S. West, Freshw. Alg. Ork. and Shetl. 1905, p. 14 (sep.), t. 1, f. 11, 12.

Cells very small, a little more than $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear

with a somewhat dilated extremity; semicells oblong-rectangular, lateral margins convex and biundulate, the upper undulation larger than the lower one; apex slightly protracted, truncate and emarginate in the middle, apical angles rectangular. Side view of semicell ovate, with a rounded protuberance on each side near the base. Vertical view elliptical, with a rounded protuberance at the middle on each side. Cell-wall smooth.

Zygospore unknown.

Length 20·4–27 μ; breadth 15·6–20 μ; breadth of apex 10·8–14·3 μ; breadth of isthmus 3·5–4·8 μ; thickness 11·5–14·5 μ.

England.—Scawfell Pike, Cumberland! Helvellyn and Blea Tarn, Westmoreland! Hawkshead, Lancashire! Keighley Moor, W. Yorks! Bog near Widdale Beck, and Snaizeholme Fell, N. Yorks!

Wales.—Bog above Capel Curig lakes, Glyder Fach (at 2,200 ft.), Llyn-y-cwm-ffynon, and Llyn Teyrn on Snowdon, Carnarvonshire!

Scotland.—Rhiconich, Sutherland! Clova, Forfar! Crianlarich, Perth! Moidart, Inverness! W. of Kirkwall, Orkneys!

Ireland.—Poisoned Glen and Lough Nacung, Donegal! Achill Island, Mayo! Near Oughterard, Galway! Carrantuohill, Kerry!

Geogr. Distribution.—Bernese Alps. Greenland.

We always find this small Desmid as an inhabitant of upland districts, and it retains its characters very constantly. It has been known for some time past as *Cosmarium Subreinschii* var. *Boldtiana* Schmidle, differing from typical *C. Subreinschii* in the larger and broader central protuberances, in the relatively wider and more angular apices, and in the apical notch.

Considering that so far as is known typical *C. Subreinschii* does not occur in the British Islands, whereas the Desmid in question is widely distributed and of constant character, we think there is every reason for its specific separation. Not only do we think it is better regarded as a separate species, but we regard the *distinct apical emargination*, accompanied by a large central protuberance, as characters which must place it in the genus *Euastrum*.

The specific name "*Boldtii*" could not be used as it has already been utilised by Schmidle for a species occurring in Germany, Russia, and Greenland.

36. **Euastrum pectinatum** Bréb.

(Pl. XXXIX, figs. 10–12.)

Heterocarpella pectinata Bréb. in Cheval. Microscop. et usage, Paris, 1839, p. 272 (name only).
Cosmarium pectinatum Bréb. in Menegh. Synops. Desm. 1840, p. 222.
Euastrum pectinatum Bréb. in Ralfs' Brit. Desm. 1848, p. 86, t. 14, f. 5 *a*, *b*, *d–f*; Arch. in Pritch. Infus. 1861, p. 730, t. 2, f. 10, 30; Rabenh. Flor. Europ. Algar. III, 1868, p. 180; Kirchn. Alg. Schles. 1878, p. 160; Cooke, Brit. Desm. 1886, p. 72, t. 34, f. 5; Hansg. Prodr. Algenfl. Böhm. 1888, p. 204; De Toni, Syll. Alg. 1889, p. 1068; West, Alg. W. Ireland, 1892, p. 138, t. 24, f. 7; Alg. Eng. Lake Distr. 1892, p. 723; Roy & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 197; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 65; Alg. N. Ireland, 1902, p. 28; Scott. Freshw. Plankton, I, 1903, p. 525.
Didymidium (*Euastrum*) *pectinatum* Reinsch, Algenfl. Frank. 1867, p. 123.
Euastrum pectinatum forma *typica* Boldt, Desmid. Grönland, 1888, p. 6.
Helierella pectinata Kuntze, Revis. gen. plant. 1891, p. 899.

Cells of medium size, about $1\frac{1}{2}$ times as long as broad, deeply constricted, sinus narrow and generally slightly open; semicells three-lobed; polar lobe dilated, anvil-shaped, angles rounded, apex convexo-truncate and slightly retuse in the middle; lateral lobes subquadrate, deeply retuse at the outer margin, angles acutely rounded; semicells with three large protuberances across the broadest part, and with two protuberances within the polar lobe (one on each side). Side view of semicell widely inflated below, then constricted and widening out into a dilated subtruncate apex; angles of polar and lateral lobes bilobulate. Vertical view elliptic-oblong, poles bimamillate, with three large rounded-conical protuberances on each side; polar lobe elliptic oblong, poles bimamillate, and with two rounded-conical protuberances at each side. Cell-wall finely punctate (sometimes almost smooth).

Zygospore globose or oblong-ellipsoid, furnished with many elongated, blunt papillæ.

Length 69–73 μ; breadth 44–47 μ; breadth of polar lobe 32–35 μ; breadth of isthmus 11·5–12 μ; thickness 33–36 μ; diam. of globose zygosp. without papillæ

52–57 μ; length of oblong zygosp. 50–73 μ; breadth 35–40 μ; length of papillæ 3–5·7 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W., N., and E. Yorks (zygospore from Adel Bog, W. Yorks)! Lancashire! Cheshire (*Ralfs*). Essex! Surrey (zygospores from Thursley Common)! Sussex (*Ralfs*). Kent! Hants! (*Ralfs*). Wilts! Devon! (*Bennett*). Cornwall (zygospores from Gunwen Moor)! (*Ralfs*).

Wales.—Generally distributed and often abundant!

Scotland.—Very common!, zygosporès from Slewdrum and Albagie, Aberdeen (*Roy & Bissett*). Outer Hebrides (zygospores not uncommon)! Orkneys! Shetlands!

Ireland.—Common (zygospores from Ballynahinch, Galway)!

Geogr. Distribution.—France. Germany. Galicia in Austria. Italy. Norway. Sweden. Denmark. Bornholm. Finland. Faeroes. Iceland. Greenland. United States. Patagonia (var.).

E. *pectinatum* is very widely distributed in all parts of the British Islands, but the type form is not so abundant as var. *inevolutum*. The bluntly-conical protuberances of this *Euastrum* are very characteristic and are best seen from the vertical view. The angles of the polar lobe and the upper and lower angles of the lateral lobes are bilobulate, so that in the vertical view there are two conical protuberances at each pole, both of the lower part of the semicell and of the polar lobe. Thus, the outline in vertical view shows ten protuberances in the lower part of the semicell and eight in the polar lobe.

The zygospores are more frequently met with than those of any other *Euastrum*.

Var. **inevolutum** West & G. S. West (Pl. XXXIX, figs. 13–15.)

E. pectinatum var. *inevolutum* West & G. S. West, Freshw. Alg. Ork. and Shetl. 1905, p. 15 (sep.), t. 1, f. 13, 14.

Cells a little smaller than in the type; lateral lobes generally more quadrate, outer margins only slightly retuse; neck of polar lobe relatively broader and shorter; apex of polar lobe more convex and retuse in the middle, apical angles more rounded; protuberances

of lower part of semicell and particularly of polar lobe much reduced (as seen in vertical view).

Length 51–63 μ; breadth 36–42 μ; breadth of polar lobe 24–28 μ; breadth of isthmus 10–11·5 μ; thickness 21–26 μ.

England.—More frequent than the type!

Wales.—General in Carnarvonshire!

Scotland.—General and abundant!

Ireland.—General and abundant!

E. pectinatum forma *intermedia* Boldt ('Desm. Grönland,' 1888, p. 6, t. 1, f. 3) comes very near this variety, but in Boldt's form the polar lobe is very small and its lateral margins are almost vertical. Boldt does not state whether the protuberances are reduced in his form or not, whereas this is one of the leading features in var. *inevolutum*. In the latter variety the angles of the polar lobe and the lateral lobules are broadly truncate or truncate-emarginate in vertical view, scarcely bilobulate as in the type.

Var. **brachylobum** Wittr. (Pl. XXXIX, fig. 16.)

E. pectinatum var. *brachylobum* Wittr. Gotl. Öl. sötv. Alg. 1872, p. 48, t. 4, f. 5; De Toni, Syll. Alg. 1889, p. 1068; Roy & Biss. Scott. Desm. 1893, p. 177.

Lobes of semicell broad and very short, margins widely retuse; semicells with six protuberances, one in the centre, one within the middle of the polar lobe, and one within each angle of the lateral lobes; poles of vertical view simple and rounded (not emarginate).

Length 70 μ; breadth 50 μ; breadth of polar lobe 32 μ; breadth of isthmus 15 μ; thickness 33 μ.

Scotland.—"Not so common" (*Roy & Bissett*).

Geogr. Distribution.—Sweden.

We have never seen any form of *E. pectinatum* at all approaching var. *brachylobum* Wittr.

Ralfs in his 'British Desmids' describes and figures a form (p. 86, t. 14, f. 5*c*) which he calls "var. β." He states that the angles of the polar lobe are slightly emarginate in front view, but it must be remembered that this effect is produced when the cell is in a slightly-oblique position, and his figure undoubtedly gives one the idea that this was the case.

37. **Euastrum gemmatum** Bréb.
(Pl. XXXIX, fig. 19.)

Cosmarium gemmatum Bréb. in Menegh. Synops. Desm. 1840, p. 221.
? *Euastrum papulosum* Kütz. Phyc. germ. 1845, p. 135.
Euastrum gemmatum Bréb. in Ralfs, Brit. Desm. 1848, p. 87, t. 14, f. 4 Näg. Gatt. einzell. Alg. 1849, p. 120; Rabenh. Flor. Europ. Alg. III, 1868, p. 180; Kirchn. Alg. Schles. 1878, p. 160; Wolle, Desm. U. S. 1884, p. 101, t. 28, f. 3, 4; Cooke, Brit. Desm. 1886, p. 73, t. 35, f. 1; Hansg. Prodr. Algenfl. Böhm. 1888, p. 204; De Toni, Syll. Alg. 1889, p. 1070; West, Alg. W. Ireland, 1892, p. 138; Alg. Eng. Lake Distr. 1892, p. 723; Roy & Biss. Scott. Desm. 1893, p. 177; Nordst. Index Desm. 1896, p. 129; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 65; Alg. N. Ireland, 1902, p. 28; Scott. Freshw. Plankton, I, 1903, p. 525.
E. (*Eucosmium*) *Hassallianum* Näg. Gatt. einzell. Alg. 1849, p. 121, t. 7 B.
E. gemmatum a. *typicum* Racib. Nonn. Desm. Polon. 1885, p. 94.
Helierella gemmata Kuntze, Revis. gen. plant. 1891, p. 898.

Cells rather small, almost $1\frac{1}{2}$ times as long as broad, very deeply constricted, sinus narrowly linear with a dilated extremity; semicells three-lobed; polar lobe short, somewhat cuneiform, with rounded angles and a retuse apex; lateral lobes subquadrate, lateral margins deeply retuse, angles broadly rounded; semicells with three prominent protuberances across the broadest part, one in the centre, and one within each lateral lobe. Side view of semicell with the lower part widely inflated, then narrowed to form a neck, which widens out, forming a dilated apical portion, apex retuse, apical angles rounded. Vertical view elliptic, with three large rounded protuberances at each side; polar lobe subquadrate (almost cruciform) with deeply retuse sides and rounded angles. Cell-wall finely granulate, granules especially prominent on all the rounded angles and protuberances.

Zygospore unknown.

Length 48–70 μ; breadth 38–47 μ; breadth of isthmus 12–14 μ; thickness 26–30 μ.

England. — Cumberland! Westmoreland! (*Ralfs*). N. Yorks! Lancashire! Sussex (*Ralfs*). Hants! (*Ralfs*). Devon! Cornwall! (*Ralfs*).

Wales.—Capel Curig! (*Cooke & Wills*) and Glyder Fawr (*Roy*), Carnarvonshire.

Scotland.—Sutherland! Ross, Inverness, Aberdeen,

Kincardine, Forfar, Perth! (*Roy & Bissett*). Outer Hebrides! Shetlands!

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Belgium. Germany. Galicia in Austria. Norway. Sweden. Denmark. Bornholm. Poland. S. Russia. Faeroes. Greenland. India. United States. W. Indies. Brazil. Paraguay.

E. gemmatum is one of the prettiest and most characteristic species of the genus. It is widely distributed, but somewhat scarce.

38. **Euastrum verrucosum** Ehrenb.

(Pl. XL, fig. 1.)

Euastrum verrucosum Ehrenb., 1834; Infus. 1838, p. 162, t. 12, f. v; Ralfs in Ann. Mag. Nat. Hist. 1844, p. 189, t. 6, f. 3; Hass. Brit. Freshw. Alg. 1845, p. 379, t. 91, f. 7; Ralfs, Brit. Desm. 1848, p. 79, t. 11, f. 2; Arch. in Pritch. Infus. 1861, p. 728; Rabenh. Flor. Europ. Algar. III, 1868, p. 179; Delp. Desm. Subalp. 1873, p. 94, t. 6, f. 13–15; Kirchn. Alg. Schles. 1878, p. 160; Wolle, Desm. U. S. 1884, p. 100, t. 26, f. 1, 5; Cooke, Brit. Desm. 1886, p. 63, t. 31, f. 1; Hansg. Prodr. Algenfl. Böhm. 1888, p. 204; De Toni, Syll. Alg. 1889, p. 1066; West, Alg. W. Ireland, 1892, p. 136; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 178; Nordst. Index Desm. 1896, p. 268; West & G. S. West, Alg. S. England, 1897, p. 483; Alga-fl. Yorks. 1900, p. 65; Alg. N. Ireland, 1902, p. 27; Scott. Freshw. Plankton, I, 1903, p. 525.
E. verrucosum a. *typicum* Racib. Nonn. Desm. Polon. 1885, p. 94.
E. verrucosum a. *typicum* Boldt, Desm. Grönland, 1888, p. 6.
Heliorella verrucosa Kuntze, Revis. gen. plant. 1891, p. 899.

Cells moderately large, subhexagonal, a little longer than broad, deeply constricted, sinus open for half its length and then narrowly linear; semicells three-lobed, interlobular incisions deep but open; polar lobe widely cuneate, angles rounded and granulate, apex deeply retuse; lateral lobes wider than polar lobe, cuneate and bilobulate, lower lateral lobule subconical, rounded, granulate and horizontally directed, upper lateral lobule submamillate, granulate, upwardly and outwardly diverging; semicells with three large protuberances across the broadest part, the central one being the largest, each protuberance furnished with large wart-like granules arranged in concentric circles. Cell-wall granulate, granules most evident at the angles where

they are often sharp and conical. Side view of semicell widely inflated in the lower part owing to the verrucose central protuberances showing at each side, then narrowed to form a "neck"; apical portion dilated, angles rounded, apex retuse. Vertical view elliptic, poles mamillate and granulate, with three large subverrucose protuberances on each side, upper and lower lateral lobules entire; polar lobe oblong-rectangular, with retuse sides and rounded angles.

Zygospore unknown.

Length 93–114 μ; breadth 75–92 μ; breadth of isthmus 19–22 μ; thickness 53–55 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W. and N. Yorks! Lancashire! Leicestershire (*Roy*). Warwick (*Wills*). Middlesex (*Hassall*). Surrey! (*Ralfs*). Sussex (*Ralfs*). Kent! (*Ralfs*). Hants! (*Ralfs*). Cornwall! (*Ralfs*).

Wales.—Capel Curig! (*Cooke & Wills*), Llyn Ogwen!, Glyder Fawr (*Roy*), Carnarvonshire.

Scotland.—Generally distributed! (*Roy & Bissett*). Frequent in the plankton! Shetlands!

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Armagh! Londonderry!

Geogr. Distribution.—France. Germany. Galicia in Austria. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. Poland. W., Central, and S. Russia. Faeroes. Greenland. Siberia. Japan. India. Australia. Central Africa. United States. Uruguay. Argentina.

E. verrucosum is not so abundant as some of the other large species of *Euastrum*. It is not often found in bogs, having a decided preference for the margins of large, reedy ponds and lakes. It cannot easily be confused with any other species of the genus.

Var. **reductum** Nordst. (Pl. XL, figs. 2, 3.)

E. verrucosum var. *reductum* Nordst. Alg. et Char. I, 1880, p. 9, t. 1, f. 14; De Toni, Syll. Alg. 1889, p. 1067; West & G. S. West, Alg. N. Ireland, 1902, p. 27; Scott. Freshw. Plankton, I, 1903, p. 525.

Cells rather smaller than in the type; polar lobe subrectangular, angles rounded, apex faintly retuse; lateral lobes retuse, scarcely bilobulate, angles rounded; interlobular incisions widely open, subrectangular; protuberances within the lateral lobes much reduced, scarcely evident in the vertical view; vertical view of polar lobe rectangular with straight sides.

Length 80–89 μ; breadth 70–86 μ; breadth of isthmus 18·5–22 μ; breadth of polar lobe 29–36 μ; thickness 36–42 μ.

Scotland.—Plankton of Lochs Tay and Achray, Perth! Plankton of Loch Ruar, Sutherland! (*J. Murray*). General in the plankton in Inverness, Lewis, and Harris, Outer Hebrides! Plankton of Neugles Water, and of Loch Beosetter, Bressay, Shetlands!

Ireland.—Lough Gartan, Donegal!

Geogr. Distribution.—Finmark in Norway. N. Russia. United States. Uruguay. Argentina.

Var. **coarctatum** Delp. (Pl. XL, fig. 4.)

E. verrucosum var. *coarctatum* Delp. Desm. subalp. 1873, p. 95, t. 6, f. 16; Racib. Nonn. Desm. Polon. 1885, p. 94, t. 13, f. 11; De Toni, Syll. Alg. 1889, p. 1067; West, Alg. W. Ireland, 1892, p. 136 (forma).

Cells slightly smaller than in the type, sinus generally more closed; polar lobe prominent, exserted, apex only slightly retuse; lateral lobes scarcely bilobulate, widely retuse.

Length 92·5–97 μ; breadth 85–87 μ; breadth of polar lobe 31–35 μ; breadth of isthmus 20–23 μ.

Ireland.—Derryclare Lough, Galway!

Geogr. Distribution.—Galicia in Austria. Poland. Italy.

A form of this variety is figured in which the upper angles of the lateral lobes are much reduced, and the polar lobe appears still more prominent; length 90 μ; breadth 76 μ; breadth of polar lobe 32·5 μ; breadth of isthmus 21 μ (Pl. XL, fig. 5). This form was originally figured in West, 'Alg. W. Ireland,' 1892, t. 20, f. 11.

Var. **alatum** Wolle. (Pl. XL, fig. 6.)

E. verrucosum var. *alatum* Wolle, Desm. U.S. 1884. p. 101, t. 26, f. 4; De Toni, Syll. Alg. 1889, p. 1067; Anderss. Sverig. Chlor. 1890, p. 10; Gutw. Flor. Glon. Okolic Lwowa, 1891, p. 72; West, Alg. W. Ireland, 1892, p. 136.

Cells with the outer half of the sinus open and then partially closed again, causing the basal angles of the semicells to have a hooked appearance.

Length 84–110 μ; breadth 71–108 μ; breadth of isthmus 22 μ; thickness 41 μ.

Scotland.—Tarbert, Harris, Outer Hebrides!

Ireland.—Cloonee Lough, Kerry!

Geogr. Distribution.—Galicia in Austria. Sweden. N. Russia. United States.

Var. **planctonicum** West & G. S. West. (Pl. XL, fig. 7.)

E. verrucosum var. *planctonicum* West & G. S. West, Scott. Freshw. Plankton, I, 1903, p. 537, t. 15, f. 4.

Cells with a widely open sinus; lateral lobes entire, obtusely conical.

Length 90 μ; breadth 91 μ; breadth of isthmus 19·5 μ.

Scotland.—In the plankton of Lochs Ruar and Nan Cuinne, Sutherland! (*J. Murray*).

This remarkable variety occurred plentifully in the plankton of Loch Ruar. A few specimens were observed in which there was a slight indication of the presence of the superior lateral lobules.

39. **Euastrum occidentale** West & G. S. West. (Pl. XXXIX, fig. 20.)

? *Cosmarium protractum* Wolle, Desm. U.S. 1884, p. 83, t. 17, f. 27, 28 [not *C. protractum* (Näg.) De Bary, 1858].

Euastrum verrucosum Ehrenb. var. *simplex* Josh. New and Rare Desm. 1885, p. 34, t. 254, f. 2; West, Alg. N. Wales, 1890, p. 287.

E. verrucosum Ehrenb. var. *simplex* Josh. forma *tumescens* Turn. Freshw. Alg. E. India, 1893, p. 74, t. 11, f. 9*.

E. occidentale West & G. S. West, Some Desm. U.S. 1898, p. 293.

Cells of medium size, about $1\frac{1}{3}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated apex; semicells truncate-pyramidate, broadly

rounded (very slightly subrectangular), superior part of lateral margins retuse, apex somewhat protracted, convex-truncate and retuse-emarginate in the middle, superior angles rounded. Side view of semicell ovate-truncate. Vertical view elliptic, poles slightly angular, with a very slight inflation at the middle on each side. Cell-wall finely granulate, granules much reduced in the centre of the semicells, and quite absent at and just below the apical emargination, often with an arc of larger granules in the middle of the semicells about two-thirds the length from the base.

Zygospore unknown.

Length 85–89 μ (rarely only 65 μ); breadth 71–72 μ (rarely only 60 μ); breadth of apex 33–37 μ (rarely only 27 μ); breadth of isthmus 20 μ; thickness 36–42 μ.

Wales.—Llyn Coron, Anglesey!

Geogr. Distribution.—Canada. United States.

We have only once observed this *Euastrum* from the British Islands, but have examined numerous specimens from Nova Scotia, Maine, and Massachusetts. Fig. 20, Pl. XXXIX, is the first accurate figure of this Desmid published, and so that there should be no doubt as to its identity *the drawing was made from one of Joshua's original specimens.*

Borge ('Alg. erst. Regnell. Exped.,' II, Desmid. 1903, p. 99) suggests a relationship between *E. occidentale* and *Cosmarium Turpinii* Bréb., but the latter is considerably smaller, with *two* small central protuberances, and without an emarginate apex. We know *C. Turpinii* very well, as it is frequent in some parts of the British Islands, and it never has such a protracted apex as *E. occidentale.*

E. occidentale has very little in common with *E. verrucosum.* For the reasons for adopting the specific name "*occidentale*" consult West & G. S. West, 'Some Desm. U.S.' 1898, p. 293.

40. **Euastrum insulare** (Wittr.) Roy.

(Pl. XL, figs. 11–13.)

Euastrum binale (Turp.) Ehrenb. var. *insulare* Wittr. Gotl. Öl, sötv. Alg. 1872, p. 49, t. 4, f. 7; Arch. in Quart. Journ. Micr. Sci. 1873, p. 434; Cooke, Brit. Desm. 1886, p. 76, t. 35, f. 10; De Toni, Syll. Alg. 1889, p. 1085; West, Alg. W. Ireland, 1892, p. 140; Johns. Rare Desm. U. S. 1894, p. 286, t. 211, f. 8.

E. insulare (Wittr.) Roy in Scott. Naturalist, April 1877; July, 1883; Roy & Biss. Scott. Desm. 1893, p. 177; West & G. S. West, Alg. S.

England, 1897, p. 484; Alga-fl. Yorks. 1900, p. 65; Chlorophy. Koh Chang, 1901, p. 85; Alg. N. Ireland, 1902, p. 29; Freshw. Alg. Ceylon 1902, p. 156.

Cosmarium insulare (Wittr.) Schmidle, Chlorophy-Fl. Torfstiche Virnheim, 1894, p. 59.

Cells minute, $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear, with a dilated extremity; semicells three-lobed, interlobular incisions subrectangular; polar lobe widely rectangular, angles rounded, apex truncate and retuse-emarginate in the middle; lateral lobes short, basal angles subrectangular, sides slightly retuse. Side view of semicell ovate, with a slight protuberance on each side. Vertical view elliptic, with a very slight protuberance at the middle on each side. Cell-wall smooth.

Zygospore unknown.

Length 17·5–30 μ; breadth 11·5–22 μ; breadth of isthmus 3·3–6 μ; thickness 9·5–11·5 μ.

England. — Westmoreland! (*Bissett*). N. Yorks! Lincolnshire! Cambridgeshire (Wicken Fen)! Hants! (*Roy*). Devon! Cornwall (*Bennett*).

Wales. — Llyn Bodrie, Anglesey! Frequent in Carnarvonshire!

Scotland.—Sutherland! Ross! Inverness, Aberdeen, Kincardine, Forfar, Perth!, Argyll (*Roy & Bissett*). Outer Hebrides!

Ireland.—Near Glenties, Loughs Anna and Akibbon, Donegal! Lower Lake of Killarney, Kerry! Dublin and Wicklow (*Archer*). Lough Derryadd, Armagh!

Geogr. Distribution.—Galicia in Austria. Norway. Sweden. Siam. United States.

This small and characteristic species is widely distributed and sometimes occurs in abundance. It was originally described as a variety of *Euastrum binale*, but the distinctly three-lobed semicells and the rectangular basal angles sufficiently characterize it.

A form of it was described from Cambridgeshire (*vide* G. S. West, 'Alga-fl. Cambr.' 1899, p. 114, t. 396, f. 11) in which the lateral lobes were less rectangular and almost bilobulate. Length 28 μ; breadth 19 μ; breadth of isthmus 5 μ; thickness 11 μ (Pl. XL, fig. 14).

41. **Euastrum crassangulatum** Börg.

(Pl. XXXIX, fig. 17.)

Euastrum crassangulatum Börg. Desm. Brasil. 1891, p. 37, t. 3, f. 25.

Cells minute, $1\frac{1}{3}$ times longer than broad, deeply constricted, sinus narrowly linear; semicells quadrate-pyramidate, angles slightly rounded, basal angles sub-rectangular, upper part of lateral margins retuse, apex broadly truncate and retuse-emarginate in the middle; semicells with a protuberance in the centre, and a smaller one within each basal and apical angle. Side view of semicell broadly ovate, upper part of lateral margins slightly retuse, apex truncate. Vertical view elliptic, with a slight protuberance at the middle on each side. Cell-wall thickened at all the angles of the semicells.

Zygospore unknown.

Length 27 μ; breadth 18 μ; breadth of isthmus 5 μ; thickness 13 μ.

Geogr. Distribution.—Austria (var.). Brazil.

The typical form is not known to occur in the British Islands.

Var. **ornatum** West. (Pl. XXXIX, fig. 18.)

E. crassangulatum var. *ornatum* West, Alg. W. Ireland, 1892, p. 140, t. 20, f. 16.

Semicells with 5 granules around the central protuberance and one in the middle, and with 6 others at regular intervals within the margins.

Length 27 μ; breadth 17·5 μ; breadth of isthmus 4·5 μ; thickness 14 μ.

Ireland.—Ballynahinch, Galway!

42. **Euastrum Cornubiense** *sp. nov.*

(Pl. XL, fig. 8.)

Cells minute, about $1\frac{1}{2}$ times longer than broad, very deeply constricted, sinus narrowly linear with a dilated extremity; semicells three-lobed, incisions between the

lobes widely subrectangular; polar lobe broadly rectangular, angles rounded, apex convex with a strong median thickening; lateral lobes short, angles rounded, outer margins retuse; semicells with a central papillate protuberance. Side view of semicell elliptic, with an acute papilla at the middle on each side. Vertical view elliptic, with an acute papilla at the middle on each side. Cell-wall smooth and slightly thickened at the base of all the sinuations.

Zygospore unknown.

Length 24 μ; breadth 15 μ; breadth of isthmus 3·8 μ; thickness 11·5 μ.

England.—Near Senens, Cornwall!

This species forms one of the connecting links between the genera *Euastrum* and *Cosmarium*. There is no actual emargination of the apex of the semicells, although there is a thickened internal ridge occupying its place. It might equally well be called *Cosmarium Cornubiense* West & G. S. West.

43. **Euastrum crassicolle** Lund.

(Pl. XL, figs. 9, 10.)

Euastrum crassicolle Lund. Desm. Suec. 1871, p. 23, t. 2, f. 8; West, Alg. N. Wales, 1890, p. 288; Roy & Biss. Scott. Desm. 1893, p. 176; Nordst. Index Desm. 1896; West & G. S. West, Alga-fl. Yorks. 1900, p. 65.
E. crassicolle a. *typicum* Racib. Nonn. Desm. Polon. 1885, p. 91.
Helierella crassicollis Kuntze, Revis. gen. plant. 1891, p. 898.

Cells minute, about twice as long as broad, deeply constricted, sinus narrowly linear; semicells truncate-pyramidate, almost three-lobed; polar lobe prominent, wide, slightly dilated, angles rounded, apex emarginate; lateral lobes very short, somewhat bilobulate with rounded angles. Side view of semicell oblong-pyramidate, apex truncate, lateral margins towards the base biundulate. Vertical view elliptic, poles truncate, and with a broad inflation at the middle on each side. Cell-wall smooth.

Zygospore unknown.

Length 24·5–28 μ; breadth 13·5–15 μ; breadth of isthmus 5·2–8·5 μ; thickness 9·5–11 μ.

England.—Mickle Fell, N. Yorks!

Wales.—Capel Curig and Llyn Padarn, Carnarvonshire! Dolgelly, Merioneth!

Scotland.—Poolewe, Ross; Presswhin and Bogwartle in Cromar, and Glen Ey, Aberdeen; Canlochan, Forfar; Rannoch, Perth (*Roy & Bissett*). Craig an Lochan, Perth! New Galloway, Kirkcudbright!

Ireland.—Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Galicia in Austria (var.). Norway. Sweden. Poland. N. Russia. Nova Zembla. Spitzbergen. Greenland. United States.

The side view of this species easily distinguishes it from any other *Euastrum*. It seems to be chiefly a northern species.

44. **Euastrum crispulum** (Nordst.) *nob.*

(Pl. XL, figs. 15–18.)

Euastrum sublobatum Bréb. var. *crispulum* Nordst. Norges Desm. 1873, p. 10, t. 1, f. 9; De Toni, Syll. Alg. 1889, p. 1042; West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 113.

E. pyramidatum West, Alg. W. Ireland, 1892, p. 139, t. 20, f. 13 (figures not good); Alg. Eng. Lake Distr. 1892, p. 723; Nordst. Index Desm. 1896, p. 215; West & G. S. West, Alg. S. England, 1897, p. 484; Some Desm. U. S. 1898, p. 287, t. 16, f. 14.

? *E. binale* (Turp.) Ehrenb. var. *elongatum* Lütkem. Desm. Attersees, 1892, p. 559, t. 8, f. 11.

Cells minute, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells pyramidate-truncate, basal angles rounded, with a slight undulation above the basal angles, upper part of lateral margins retuse; apex widely truncate, distinctly emarginate in the middle, that part on each side of the apical emargination distinctly retuse, apical angles acutely rounded. Side view of semicell ovate, slightly narrowed near the rounded apex. Vertical view elliptical with a broad inflation at each side. Cell-wall smooth.

Zygospore unknown.

Length 25–28 μ; breadth 16–20 μ; breadth of apex 9–11 μ; breadth of isthmus 3·5–7·5 μ; thickness 12·5–15 μ.

England.—Loughrigg, Westmoreland! Thursley Common, Surrey! Withiel, Cornwall!

Scotland.—Rhiconich, Sutherland! Lewis, Outer Hebrides!

Ireland.—Ballynahinch, Kylemore, and Roundstone, Galway!

Geogr. Distribution.—Norway. W. Africa. United States.

The Desmid we described from Ireland as *Euastrum pyramidatum* is identical in every respect with that described by Nordstedt from Norway as *Euastrum sublobatum* var. *crispulum*. It is a very constant species, easily distinguished from *E. sublobatum*, and we have therefore placed it as *Euastrum crispulum*.

It is smaller than *E. sublobatum*, the semicells are pyramidate (not quadrate), and the undulations above the basal angles and the undulated character of the apex are features which are never present in *E. sublobatum*. In the vertical and side views the central inflation of *E. crispulum* appears very much smaller than that of *E. sublobatum*.

45. **Euastrum sublobatum** Bréb.

(Pl. XL, fig. 19.)

Euastrum sublobatum Bréb. in Ralfs' Brit. Desm. 1848, p. 91, t. 32, f. 4; Nordst. Index Desm. 1896, p. 245.

Cosmarium sublobatum (Bréb.) Arch. in Pritch. Infus. 1861, p. 731; Rabenh. Flor. Europ. Algar. III, 1868, p. 168; Kirchn. Alg. Schles. 1878, p. 152; Wolle Desm. U.S. 1884, p. 80, t. 18, f. 21, 23; Cooke, Brit. Desm. 1886, p. 79, t. 36, f. 1; De Toni, Syll. Alg. 1889, p. 1041; West. Alg. Eng. Lake Distr. 1892, p. 723; West and G. S. West, Alga-fl. Yorks. 1900, p. 90; Alg. N. Ireland, 1902, p. 32.

Ursinella sublobata Kuntze, Revis. gen. plant. 1891, p. 925.

Cells small, about $1\frac{1}{2}$ times as long as broad, deeply constricted, sinus narrowly linear with a widely-dilated extremity; semicells subquadrate, lateral margins retuse, basal angles rounded, superior angles more acutely rounded, apex convex-truncate, retuse-emarginate in the middle. Side view of semicell ovate, with a large protuberance on each side near the base, upper part of lateral margins retuse, apex rounded; vertical view elliptic, with a large protuberance in the middle on each side, giving it a subcruciform appearance. Cell-wall smooth.

Zygospore unknown.

Length 26·5–48 μ; breadth 20–39 μ; breadth of apex 19–26 μ; breadth of isthmus 5·2–12·5 μ; thickness 18–21 μ.

England.—Borrowdale and Scarf Gap Pass, Cumberland! Westmoreland! (*Ralfs*). Ogden Clough, Penyghent, Oughtershaw Tarn, and Cautley Spout, W. Yorks!

Wales.—Bettws-y-coed, Twll Du, and Llyn Teyrn on Snowdon, Carnarvonshire! Dolgelly, Merioneth (*Ralfs*).

Scotland.—Sutherland!, Ross, Inverness, Aberdeen, Kincardine, Forfar, Perth, Argyll (*Roy & Bissett*).

Ireland.—Lough Fea, Londonderry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Galicia and Austria. Hungary. Italy. Norway. Poland. S. Russia. Greenland. New Zealand (var.). United States. W. Indies. Paraguay (var.).

We think this Desmid is better regarded as a species of *Euastrum* rather than of *Cosmarium* on account of the retuse-emarginate apex of the semi-cells, with which is associated a relatively large central protuberance. It is essentially an upland species.

Var. **dissimile** Nordst. (Pl. XLV, fig. 7.)

Cosmarium sublobatum (Bréb.) Arch. subsp. *dissimile* Nordst. Desm. Ital. 1876, p. 39, t. 12, f. 15.

Cells less deeply constricted, the breadth of the isthmus being about two-thirds that of the cell. Angles of semicells dissimilar; in vertical view with the superior angles truncate and the inferior angles retuse. Side view of semicell broadly truncate-pyramidate, with a small basal tumour.

Length 26–28·5 μ; breadth 17–20 μ; breadth of isthmus 12–13 μ; thickness 13–14 μ.

Scotland.—Loch Luichart, Ross!

Ireland.—Dublin and Wicklow (*Archer*).

Geogr. Distribution.—Italy.

Var. **subdissimile** *var. nov.* (Pl. XL, fig. 20.)

Cells with a broader isthmus; semicells with larger

basal angles, the retuse portion of the lateral margin being nearer the apex; apex widely convex and retuse-emarginate in the middle. Side view of semicell quadrate-pyramidate, inferior and superior angles rounded, sides and apex retuse. Vertical view oblong-rectangular, angles rounded, poles retuse, with a prominent protuberance at the middle on each side; polar lobe rectangular, angles round, sides and poles retuse.

Length 34·5 μ; breadth 22 μ; breadth of apex 18 μ: breadth of isthmus 9·5 μ; thickness 17 μ.

Scotland.—Near Tarbert, Harris, Outer Hebrides!

This variety somewhat resembles the previous one, but the general outline of the semicells is rather different, and the side and vertical views differ greatly in the amount of the retuseness of the poles.

46. **Euastrum validum** West and G. S. West.

(Pl. XL, figs. 21, 22.)

Euastrum validum West and G. S. West, Some N. Amer. Desm. 1896, p. 245, t. 14, f. 32, 33; Freshw. Alg. Ceylon, 1902, p. 156.

Cells minute, $1\frac{1}{3}$ times longer than broad, very deeply constricted, sinus narrowly linear with a dilated extremity; semicells truncate-pyramidate, lateral margins retuse, inferior angles inflated, superior angles somewhat rounded and sometimes slightly thickened; apex broad, truncate-convex, emarginate and thickened in the middle; semicells with a small papilla within each basal angle, a large granule in the middle, close to the isthmus, and a small scrobiculation near the centre. Side view of semicell ovate, with a granule near the isthmus on each side; vertical view elliptic, with a small papilla on either side of each pole. Cell-wall smooth.

Zygospore unknown.

Length 26·5–30 μ; breadth 19–22 μ; breadth of apex 13·5–14·5 μ; breadth of isthmus 4·4–4·5 μ; thickness 10–11 μ.

Scotland.—Rhiconich, Sutherland! Loch Diracleet, near Tarbert, Harris, Outer Hebrides!

Geogr. Distribution.—Ceylon. United States.

This species is on the border-line between the genera *Euastrum* and *Cosmarium*, but we are inclined to retain it in the former genus on account of the distinctly emarginate apices.

It has two near relatives in *Cosmarium subbinale* (Nordst.) Lagerh. and *C. miedzyrzecense* Eichl. & Gutw., neither of which are known to occur in Britain.

Note.—In his 'Freshw. Alg. Eng. Lake Distr.,' 1886, Bennett figures very roughly a Desmid which he terms "*Euastrum crenatum* Kütz." His short description and his outlined figure do not agree, however, with Kützing's description of *E. crenatum*. What Bennett's plant was we do not know, neither is the information he gives concerning it of sufficient value to establish a species. It seems to us that it might *possibly* be a form of *Cosmarium tetragonum* Näg.

Genus 14. **MICRASTERIAS** Ag., 1827.

Ag. in Flora, 1827, p. 642.
Menegh. Synops. Desm. 1840, p. 214.
Ralfs, in Ann. Nat. Hist. 1844, p. 259.
Hass. Brit. Freshw. Alg. 1845, p. 385.
Ralfs, Brit. Desm. 1848, p. 68.
De Bary, Conj. 1858, pp. 39, 40, 47, 50, 70.
Arch. in Pritch. Infus. 1861, pp. 720, 725.
Rabenh. Flor. Europ. Alg. III, 1868, p. 187.
Wolle, Desm. U.S. 1884, p. 108.
Cooke, Brit. Desm. 1886, p. 53.
Hansg. Prodr. Algenfl. Böhm. 1888, p. 207.
De Toni, Syll. Alg. 1889, p. 1109.
G. S. West, Treatise Brit. Freshw. Alg., 1904, p. 165.

Cells of variable size, often large, usually a little longer than broad, sometimes subcircular in general outline, *usually much compressed*, very deeply constricted in the middle, sinus usually linear (open outwards in several species); semicells subsemicircular, usually five-lobed (in some species three-lobed); polar lobe generally widely cuneate, emarginate, or widely notched; lateral lobes usually bilobulate, lobules generally slightly bilobed; median part of base of semicells generally without protuberances; vertical view elliptic-lanceolate or linear-lanceolate; one lobed chloroplast in each semicell, with many scattered pyrenoids.

Zygospores globose, radially ornamented with stout spines, either simple, bifid, trifid, or quadrifid at their apices.

This genus includes some of the handsomest of British Desmids, many of the species being remarkable for the elegance of the lobulation of the semicells. There is always an odd number of lobes to each semicell, the middle one being differentiated from the rest as the *polar lobe*.

Many of the species are flattened and disc-shaped, the cells being relatively much thinner than in any other genus of Desmids. Certain species connect this genus both with *Euastrum* and *Xanthidium*.

Micrasterias and *Euastrum* were both included by Kuntze in his genus "*Helierella*," but we have previously mentioned that this name cannot be used for a genus of Desmids.

Species of this genus generally occur intermingled with other Desmids, and some of them are only found in the very richest localities for these plants, being confined to the lakes and bogs of the Older Palæozoic and Precambrian areas.

There are 18 British species, which can be arranged as follows:

Section A. (*Holocystis* Hassall.) Polar lobe entire; lateral lobes of semicells two, transversely placed, generally entire, and attenuated to their extremities.

1. *M. oscitans.*
2. *M. pinnatifida.*

Section B. (*Actinocystis* Turner.) Polar lobe with a median incision of variable depth (rarely almost absent); lateral lobes of semicells four, radiately disposed, and widening outwards.

a. Lateral lobes generally much divided; interlobular incisions narrow.

† Interlobular incisions not deep.

3. *M. truncata.*
4. *M. crenata.*
5. *M. Jenneri.*
6. *M. conferta.*

†† Interlobular incisions deeper.

7. *M. papillifera.*
8. *M. Murrayi*
9. *M. Sol.*
10. *M. apiculata.*
11. *M. rotata.*
12. *M. denticulata.*
13. *M. verrucosa.*
14. *M. Thomasiana.*

β. Lateral lobes with fewer divisions; interlobular incisions widely open.

15. *M. radiata.*
16. *M. Crux-Melitensis.*

Section C. Polar lobe with accessory processes; lateral lobes of semicells two, symmetrical or asymmetrical.

17. *M. Americana.*
18. *M. Mahabuleshwarensis.*

1. **Micrasterias oscitans** Ralfs.

(Pl. XLI, figs. 1–4.)

Micrasterias? oscitans Ralfs in Jenner's Flora Tunbridge Wells, 1845, p. 198; Ralfs, Brit. Desm. 1848, p. 76, t. 10, f. 2; Rabenh. Flor. Europ. Alg. III, 1868, p. 189; Wille, Norges Ferskv. Alg. 1880, p. 21, t. 1, f. 4, 5 (formæ); Wolle, Desm. U.S. 1884, p. 116, t. 33, f. 3, 4; De Toni, Syll. Alg. 1889, p. 1110; Roy & Biss. Scott. Desm. 1893, p. 174.
Holocystis oscitans, Hass. Brit. Freshw. Alg. 1845, p. 387, t. 90, f. 4; Bennett, Freshw. Alg. Eng. Lake Distr. 1886, p. 7, t. 1, f. 7–10.
Euastrum (*Micrasterias*) *oscitans* Näg. Gatt. einz. Alg. 1849, p. 123.
Tetrachastrum oscitans, Dixon in Proc. Dubl. Nat. Hist. Soc. 1859; p. 205; also in Quart. Journ. Micr. Sci. 1859, p. 83.
Helierella oscitans Kuntze, Rev. gen. plant. 1891, p. 899.
M. oscitans a typica Turn. Freshw. Alg. E. India, 1893, p. 88.

Cells of medium size, about as long as broad, deeply constricted, inner half of sinus usually narrowly linear, outer half open and acutely conical; semicells three-lobed; polar lobe wide, fusiform or subfusiform, with acuminate (rarely bifid) poles and a convex apex; incisions below the polar lobe deep and somewhat widely open; lateral lobes horizontal, ovate-triangular, with minutely bifid extremities. Side view of semicell elliptic-pyramidate, with a rounded apex. Vertical view elliptic-fusiform, with acuminate (very rarely bifid) poles. Cell-wall minutely punctate.

Zygospore unknown.

Length 125–146 μ; breadth 123–135 μ; breadth of polar lobe 91–95 μ; breadth below polar lobe 52–56 μ; breadth of isthmus 24–26 μ; thickness 44–52 μ.

England.—Kirk Fell, Cumberland! Westmoreland (*Ralfs*). Sussex (*Ralfs*). Chobham Common, Surrey!

Wales.—Capel Curig (*Cooke & Wills*) and Moel Siabod!, Carnarvonshire. Dolgelly, Merioneth (*Ralfs*).

Scotland.—Aberdeen (*P. Grant*).
Ireland.—Glencar, Kerry (*Archer*).
Geogr. Distribution.—France. Germany. Austria (forma). Galicia (forma). Norway. Denmark. United States.

Typical *M. oscitans* is exceedingly rare and we have only found it on three occasions. Fig. 4 (on Pl. XLI) is a drawing of a semicell from Kirk Fell, Cumberland, which agrees very well with the plant as described by Ralfs.

American specimens have been described by Wolle with a diameter (breadth) of 150–160 μ.

Var. **mucronata** (Dixon) Wille. (Pl. XLI, figs. 5, 6.)

Tetrachastrum mucronatum Dixon in Proc. Dubl. Nat. Hist. Soc. 1859, p. 204, t. 1, f. 5-8; in Quart. Journ. Micr. Sci. 1859, p. 81, t. 7; Arch. in Pritch. Infus. 1861, p. 725.
Micrasterias mucronata (Dixon) Rabenh. Flor. Europ. Alg. III, 1868, p. 187; Kirchn. Alg. Schles. 1878, p. 163; Cooke in Grevillea, 1881, p. 89, t. 141, f. 2 (in part); Cooke, Brit. Desm. 1886, p. 53, t. 20, f. 1; De Toni, Syll. Alg. 1889, p. 1112; West, Alg. N. Wales, 1890, p. 286; Alg. W. Ireland, 1892, p. 133; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 174; Nordst. Index Desm. 1896, p. 177; West & G. S. West, Alg. S. England, 1897, p. 484.
M. oscitans Ralfs var. *mucronata* (Dixon), Wille, Norges Ferskv. Alg. 1880, p. 21, t. 1, f. 3; Turn. Freshw. Alg. E. India, 1893, p. 88; West & G. S. West, Alga-fl. Yorks. 1900, p. 65.
Heliorella mucronata Kuntze, Revis. gen. plant. 1891, p. 899.

Cells proportionately longer than in the type, with the sinus more closed; lateral lobes larger and somewhat inflated, lateral angles generally furnished with two blunt teeth, and often with a third tooth above those at the angles; polar lobe flattened at the apex, and sometimes broadly retuse, lateral angles downwardly curved and generally furnished with a single blunt tooth; with the incisions below the polar lobe commonly smaller than in the type. Vertical view elliptic or elliptic-rhomboid, with acute poles.

Length 130–156 μ; breadth 104–131 μ; breadth of polar lobe 78–84 μ; breadth below polar lobe 58–64 μ; breadth of isthmus 25–33 μ; thickness 59–62 μ.

England.—Borrowdale, Cumberland! Near Winder-

mere (*Bissett*), Elter Water!, Grisedale Tarn!, and Stickle Tarn (abundant!), Westmoreland. Cronkley Fell and Lund's Fell, N. Yorks! Chobham and Thursley Commons, Surrey! Dartmoor, Devonshire!

Wales.—Capel Curig! (*Cooke & Wills*), Snowdon!, bog on Glyder Fach (at 2,200 ft.)!, Carnarvonshire. Dolgelly, Merioneth!

Scotland.—Ross, Inverness!, Aberdeen, Kincardine, Forfar, Perth, Argyll and Arran (*Roy & Bissett*). Scourie, Sutherland!

Ireland.—Kylemore, Galway! Near Carrickmore, Tyrone (*Dixon*). Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Norway. Faeroes. India.

This variety is much more frequently met with than typical *M. oscitans*, and it exhibits considerable variation. Many intermediate forms between the two occur, and this has resulted in the following names :—

M. mucronata forma *intermedia* Nordst ('Norges Desm.' 1873, p. 6).

M. oscitans var. *mucronata* forma *intermedia* Boldt (1888).

M. oscitans var. *intermedia* Turn. (1893).

As so many of these intermediate forms exist, constituting a complete series connecting *M. oscitans* with its var. *mucronata*, there is no justification for giving them varietal names. Both Cooke and Wille have figured a number of these intermediate forms.

M. oscitans var. *mucronata* is largely an upland species and sometimes occurs in quantity in mountain bogs, generally amongst the leaves of *Sphagnum cuspidatum* var. *plumosum*, and very often mixed with *Micrasterias Jenneri*, *Cosmarium Cucurbita*, *Euastrum insigne*, and other Desmids.

2. **Micrasterias pinnatifida** (Kütz.) Ralfs.

(Pl. XLI, figs. 7–11, 13.)

Euastrum pinnatifidum Kütz. Phyc. germ. 1845, p. 134.
E. bifidum Focke, Phys. Stud. 1847, p. 45, t. 1, f. 12, t. 2, f. 22.
Micrasterias pinnatifida (Kütz.) Ralfs, Brit. Desm. 1848, p. 77, t. 10, f. 3; Kütz. Spec. Alg. 1849, p. 171; Wolle, Desm. U.S. 1884, p. 116, t. 37, f. 7, 8; Cooke, Brit. Desm. 1886, p. 54, t. 20, f. 3; Hauptfl. Zellmembr. u. Hüllgallerte Desm. 1888, p. 92, t. 3, f. 4–6, 7–9, 14, 16–18; West, Alg.

W. Ireland, 1892, p. 133; Roy & Biss. Scott. Desm. 1893, p. 174; Johnson, Species of Micrasterias, 1894, p. 58, t. 6, f. 5, 6; Nordst. Index Desm. 1896, p. 201; West. & G. S. West, Some N. Amer. Desm. 1896, p. 238, t. 13, f. 28; Alg. N. Ireland 1902, p. 30; Scott. Freshw. Plankton, I, 1903, p. 526.

Euastrum didymacanthum Näg. Galt. einzell. Alg. 1849, p. 123, t. 6H, f. 1.

Tetrachastrum pinnatifidum Dixon in Quart. Journ. Micr. Sci. 1859, p. 83; Arch. in Pritch. Infus. 1861, p. 725.

Didymidium (*Micrasterias*) *pinnatifidum* Reinsch. Algenfl. Frank. 1867, p. 141.

Micrasterias oscitans Ralfs var. *pinnatifida* Rabenh. Flor. Europ. Alg. III, 1868, p. 189; Hansg. Prodr. Algenfl. Böhm. 1888, p. 208; De Toni, Syll. Alg. 1889, p. 1110; Lütkem. Desm. Attersees, 1893, p. 562.

Holocystis pinnatifida Bennett, Freshw. Alg. Eng. Lake Distr. 1886, p. 8.

Cells small, a little broader than long, deeply constricted, sinus open, triangular-acuminate with a narrowed apex; semicells 3-lobed, the interlobular incisions deep and broadly rounded; lateral lobes horizontally disposed, semifusiform, with attenuated and minutely bifid apices; polar lobe widely spreading, extremities narrower than those of the lateral lobes and minutely bifid, apex convex, straight, or sometimes very slightly retuse. Side view of semicell narrowly ovate-pyramidate, with a rounded apex. Vertical view narrowly rhomboid-lanceolate, with acuminate poles. Cell-wall very minutely punctate.

Zygospore globose, furnished with long, stout, acute spines, each arising from a blunt protuberance.

Length 53–76 μ; breadth 57–80 μ; breadth of polar lobe 39–57 μ; breadth of isthmus 12–18 μ; thickness 15–18 μ; diam. zygosp. without spines 44 μ, with spines 67 μ.

England.—Ambleside (*Ralfs*) and Bowness (*Bissett*), Westmoreland.

Wales.—Capel Curig, Carnarvonshire (*Cooke & Wills*). Dolgelly, Merioneth (*Ralfs*).

Scotland.—General, but scarce (*Roy & Bissett*). Aberdeen! Inverness! Scourie and Rhiconich, Sutherland! Fairly general in Lewis and Harris! Plankton of Loch Fadaghoda, Lewis, and of Loch Nan Eun, N. Uist!

Ireland.—Near Glenties and Lough Anna, Donegal! Ballynahinch, Roundstone, Loughs Aunierin, Athry,

Creggan, Moher, and Shannacloontippen, Galway! Adrigole, Kerry!

Geogr. Distribution.—France. Germany. Austria. Norway. Sweden. Denmark. Bornholm. Finland. Poland. Faeroes. India. Ceylon. Madagascar (var.). Central Africa (var.). United States. West Indies. Brazil.

We do not understand how any one could confuse this pretty little species with *Micrasterias oscitans* Ralfs, to which it bears only a superficial resemblance. It is one of the most distinctive species of the genus, and notwithstanding its wide geographical distribution it maintains its features very constantly.

Monstrosities of this species are sometimes found, such as those figured by Elfving ('Anteck Finska Desm.' 1881, t. 1, f. 1) and mentioned by Roy as sometimes occurring in Scotland (*vide* Roy & Biss. 'Scott. Desm.' 1893, p. 174).

One form from Ireland is worthy of special mention. We have given a figure of it on Plate XLI (fig. 12). It possesses an additional tooth above the bifid lateral angles, and was observed in quantity from Ballynahinch, Galway. The same form is known from the United States (*vide* West and G. S. West, 'Some Desm. U. S.' 1898, p. 295).

A number of varieties of this species occur in America which have not yet been found in Europe. One of these—var. *trigona* West—which is known from Maine, is particularly interesting, as it was the first triquetral specimen of a *Micrasterias* to be described.

3. **Micrasterias truncata** (Corda) Bréb.

(Pl. XLII, figs. 1–8; Pl. XLV, figs. 5, 6.)

? Euastrum Rota Ehrenb. Entwick. Lebends. d. Infus. 1832, p. 82 [for all practical purposes only a name]; Infus. 1838, p. 161, t. 12, f. 1 [in part; 1 *g* and 1 *h* = *M. truncata*].

Cosmarium truncatum Corda in Alm. de Carlsbad, 1834, p. 180, 206, t. 2, f. 23, 24.

Cosmarium quadragies-cuspidatum Corda in Alm. de Carlsbad, 1840, p. 215, t. 6, f. 40.

Micrasterias truncata (Corda) Bréb. in Ralfs' Brit. Desm. 1848, p. 75, t. 8, f. 4, t. 10, f. 5; Arch. in Pritch. Infus. 1861, p. 727; Rabenh. Flor. Europ. Alg. III, 1868, p. 199 (c. fig. 62 *b*), 191; Delp. Desm. Subalp. 1873, p. 89, t. 5, f. 6–10; Jacobs. Desm. Danem. 1875, p. 152, t. 8, f. 2–8 (formæ monstrosæ); Kirchn. Alg. Schles. 1878, p. 162; Wolle, Desm. U. S. 1884, p. 114, t. 38, f. 6; Cooke, Brit. Desm. 1886, p. 60, t. 25, f. 2; De Toni, Syll. Alg. 1889, p. 1115; West, Alg. N. Wales, 1890, p. 287;

Alg. W. Ireland, 1892, p. 135; Alg. Eng. Lake Distr. 1892, p. 722; Roy and Biss. Scott. Desm. 1893, p. 175; Nordst. Index Desm. 1896, p. 260; West & G. S. West, Alg. S. England, 1897, p. 484; G. S. West, Variation Desm. 1899, p. 383, t. 9, f. 9–16; West & G. S. West, Alga-fl. Yorks, 1900, p. 65; Alg. N. Ireland, 1902, p. 30.

Micrasterias quadragies-cuspidata (Corda) Ralfs, Brit. Desm. 1848, p. 209.

M. truncata var. *quadrata* Buln. in Hedwigia, 1859, p. 21, t. 2, f. 2.

Didymidium (*Micrasterias*) *truncatum* forma b. *dentatum* Reinsch, Algenfl. Frank. p. 144.

Micrasterias truncata var. *euastroides* De Toni, Syll. Alg. 1889, p. 1115.

M. truncata forma *incisa* De Toni, l.c.

M. truncata var. *quadragies-cuspidata* De Toni, l.c.

M. truncata var. *tridentata* Bennett, Freshw. Alg. Hamps. and Devon. 1890, p. 7 t. 1, f. 10.

Helierella truncata Kuntze, Rev. gen. plant. 1891, p. 897.

Micrasterias truncata forma *punctata* West, Alg. W. Ireland, 1892, p. 135; Alg. Eng. Lake Distr., 1892, p. 722.

Cells small, generally a little longer than broad, elliptical with widely truncate poles, deeply constricted, sinus narrowly linear, often slightly open towards the outside; semicells scarcely 5-lobed, incisions below the polar lobe moderately deep and generally somewhat open (rarely narrowly linear), incisions between the two lateral lobes slightly open and not so deep; lateral lobes somewhat variable, typically bilobulate with each lobule emarginate; polar lobe very widely cuneate (sometimes almost fusiform), apex convex and usually flattened or slightly retuse in the middle, lateral angles acuminate or emarginate. Side view of semicell broadly ovate. Vertical view fusiform-elliptic, poles acute. Cell-wall delicately or strongly punctate.

Zygospore unknown.

Length, 87–138 μ; breadth 78–129 μ; breadth of polar lobe 65–97 μ; breadth of isthmus, 18–27 μ; thickness, 36–52 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W., N., and E. Yorks! Lancashire! Cheshire (*Roy*). Warwick! (*Wills*). Gloucester. Wilts! Surrey! Sussex. Hants! Devon! Cornwall!

Wales.—Common, especially abundant in the upland bogs!

Scotland.—General and abundant! (*Roy & Bissett*). Outer Hebrides! Orkneys! Shetlands!

Ireland.—General and abundant!

Geogr. Distribution.—France. Germany. Austria. Galicia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. Poland (form). N. and S. Russia. Faeroes. N. India. Sandwich Islands. United States. Brazil.

This is one of the most abundant species of the genus, more especially in the *Sphagnum*-bogs and pools of upland districts. In almost all mountainous areas this Desmid is frequent from 800 to 2,500 ft., and it is very remarkable that its zygospore has not yet been found.

It is widely distributed throughout Europe and North America, and some twenty varieties of it have been described by different authors. Many of these so-called "varieties," however, have no claim to rank as such, as the species is a very variable one, the two semicells of the same plant often being widely different in appearance. The lobulation of the lateral lobes varies very much, and forms obtained from different localities rarely agree in the extent and disposition of their lobulation. We have given figures of a number of specimens, mostly from different localities, which show great differences in the lobulation.

Each lateral lobe is normally divided into two lobules, each lobule being emarginate. Sometimes the angles of the lobule are almost spinate, or they may be furnished with subcapitate projections (*vide* Pl. XLII, fig. 7). Sometimes the lobules are tridentate (this form having been named "var. *tridentata*" by Bennett), but many specimens occur in which some of the lobules are tridentate and others emarginate. This is shown on Pl. XLII, fig. 1. The lateral incisions exhibit much variation in the extent to which they are open or closed.

The plant described as "*Cosmarium quadragies-cuspidatum*" by Corda was only a form of this species, the author (and certain subsequent authors) having mistaken the radiating fibrillar structure of the mucous investment for an armament of spines.

The form in which the lobules are furnished at each angle with a distinct spine is very rare in the British Islands. It was first specially mentioned by Brébisson, being named by him "*Euastrum semiradiatum*" (*vide* Menegh. 'Synops. Desm.' 1840, p. 215). Kützing ('Spec. Alg.' 1849, p. 170) placed it as "*Micrasterias semiradiata*," and Cleve ('Sverig. Desm.' 1864, p. 487) as "*M. truncata* var. *semiradiata*." Istvanffi subsequently (1887) created another synonym by renaming the same form "*M. truncata* subsp. *radiosa*"!

Forma **granulata** Racib.

M. truncata forma *granulata* Racib. Desm. Nowe, 1889, p. 105, t. 7, f. 1; West, Alg. Eng. Lake Distr. 1892, p. 722; Alg. W. Ireland, 1892, p. 135.

Cell-wall densely covered with irregular granules, otherwise similar in form and size to the type.

England.—Hawkshead, Lancashire!

Ireland.—Ballynahinch and Lough Athry, Galway!

Geogr. Distribution.—Austria.

Var. **Bahusiensis** Wittr. (Pl. XLII, fig. 9.)

M. truncata var. *Bahusiensis* Wittr. Skandinav. Desm. 1869, p. 9, t. 1, f. 2; West & G. S. West, Alg. S. England, 1897, p. 484.

Cells with large outstanding polar lobes; incisions below the polar lobes widely open.

Length 110 μ; breadth 100 μ; breadth of polar lobe 83 μ.

England.—New Forest, Hants!

Scotland.—Rhiconich, Sutherland!

Geogr. Distribution.—Sweden.

This variety is well-marked by reason of the outstanding polar lobes.

4. **Micrasterias crenata** Bréb.

(Pl. XLII, figs. 10–13.)

Micrasterias crenata Bréb. in Ralfs' Brit. Desm. 1848, p. 75, t. 7, f. 2, t. 10, f. 4; Arch. in Pritch. Infus. 1861, p. 727; Delp. Desm. subalp. 1873, p. 92, t. 5, f. 17, 18; Cooke, Brit. Desm. 1886, p. 61, t. 28, f. 1; West, Alg. N. Wales, 1890, p. 287; Alg. W. Ireland, 1892, p. 135; Roy & Biss. Scott. Desm. 1893, p. 173; Nordst. Index Desm. 1896, p. 87; West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 87; Some Desm. U.S. 1898, p. 298; Alga-fl. Yorks. 1900, p. 66.

Didymidium (*Micrasterias*) *truncatum* forma a. *crenatum* Reinsch, Algenfl. Franken, 1867, p. 143.

Micrasterias truncata forma c. Rabenh. Flor. Europ. Alg. III, 1868, p. 191.

Cells small, about $1\frac{1}{5}$ times longer than broad, elliptic with truncate poles, deeply constricted, sinus narrowly linear; semicells 5-lobed, incisions between the lobes linear, those below the polar lobe considerably deeper than those between the lateral lobes; polar lobe very broadly cuneate, with a convex apex (sometimes a little flattened) and rounded angles; lateral

lobes bilobulate (rarely entire), lobules rounded-truncate or very slightly retuse. Side view of semicell widely ovate. Vertical view fusiform-elliptic. Cell-wall smooth.

Zygospore unknown.

Length 75–125 μ; breadth 54–102 μ; breadth of polar lobe 46–65 μ; breadth of isthmus 17–30 μ.

England. — Westmoreland (*Bissett*). W. and N. Yorks! Warwick (*Wills*). Sussex (*Ralfs*). Cornwall (*Marquand*).

Wales. — Near Dolbadarn Castle!, Bethesda!, Capel Curig (*Cooke & Wills*), and Snowdon (*Roy*), Carnarvonshire. Dolgelly, Merioneth (*Ralfs*).

Scotland.—Ross, Inverness, Aberdeen, Kincardine, Forfar, Perth!, Argyll, Arran, Fife (*Roy & Bissett*).

Ireland.—Kylemore, and Loughs between Clifden and Roundstone, Galway!

Geogr. Distribution.—France. Germany. Austria and Galicia. Poland. Italy. Norway. W. Africa. United States. Brazil.

The typical form of *M. crenata* seems very distinct from *M. truncata*. It is proportionately longer, with a more robust and deeper polar lobe, which is never retuse in the middle, though often flattened. The lateral angles of the polar lobe are rounded, and the lateral lobes are not so deeply incised as in *M. truncata*, the lobules possessing at the same time rounded angles.

It is unquestionably a rare species, although many forms have been recorded intermediate in character between it and *M. truncata*.

5. **Micrasterias Jenneri** Ralfs.

(Pl. XLII, fig. 14; Pl. XLIII, figs. 1, 2.)

Micrasterias Jenneri Ralfs, Brit. Desm. 1848, p. 76 (*α* and *β*), t. 11, f. 1; Arch. in Pritch. Infus. 1861, p. 727; Rabenh. Flor. Europ. Alg. III, 1868, p. 194; Cooke, Brit. Desm. 1886, p. 62, t. 28, f. 3; Hansg. Prodr. Algenfl. Böhm. 1888, p. 209; De Toni, Syll. Alg. 1889, p. 1125; West, Alg. N. Wales, 1890, p. 287; Alg. W. Ireland, 1892, p. 135; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 174; Nordst. Index Desm. 1896, p. 150; West & G. S. West, Alg. S. England, 1897, p. 484.

Helierella Jenneri Kuntze, Revis. gen. plant. 1891, p. 898.

Cells rather large, about $1\frac{1}{2}$ times as long as broad, oblong-elliptic, deeply constricted, sinus narrowly linear; semicells 5-lobed, interlobular incisions narrow and linear, not very deep, those below the polar lobe deeper than the others; lateral lobes somewhat cuneate and slightly bilobulate, each lobule retuse; polar lobe very widely cuneate, angles rounded, apex broadly convex but retuse in the middle. Side view of semicell oblong-elliptic. Vertical view oblong-fusiform, with the sides in the middle subparallel, somewhat suddenly attenuated to the poles, which are obtusely rounded. Cell-wall densely covered with irregular flattened granules of variable size, which are sometimes much reduced.

Zygospore unknown.

Length 132–170 μ; breadth 82–125 μ; breadth of polar lobe 60–81 μ; breadth of isthmus 24–33 μ.

England.—Near Stickle Tarn, Westmoreland (very abundant)! Sutton Park, Warwick (*Wills*). Thursley Common, Surrey! New Forest, Hants! (*Ralfs*). Cornwall (*Marquand*).

Wales.—Capel Curig, Carnarvonshire! (*Cooke & Wills*). Dolgelly, Merioneth! (*Ralfs*).

Scotland.—Sutherland, Ross, Inverness!, Aberdeen, Kincardine, Forfar, Perth, Argyll, and Arran (*Roy & Bissett*). Near Sligachan, Skye! Plankton of Loch Doon, Ayrshire.

Ireland.—Near Foxford, Mayo! Kylemore, Galway! Tyrone (*Archer*). Dublin and Wicklow (*Archer*). Glencar (*Archer*) and Carrantuohill!, Kerry.

Geogr. Distribution.—France. Germany. Galicia in Austria. Norway. Sweden. Denmark. New Zealand (var.). United States.

This characteristic species is very uncommon. It occurs principally in upland *Sphagnum*-areas and is sometimes found in quantity in association with *Micrasterias oscitans* var. *mucronata, Euastrum insigne, Xanthidium armatum,* etc.

The typical form is densely covered with flattened granules, but the amount of roughness varies much in different specimens.

Var. **simplex** West. (Pl. XLIII, fig. 3.)

M. Jenneri var. *simplex* West, Alg. N. Wales, 1890, p. 287, t. 6, f. 34; Alg. W. Ireland, 1892, p. 135; West and G. S. West, Alg. S. England, 1897, p. 484; Alg. N. Ireland, 1902, p. 30.
M. Jenneri forma *Brasiliensis* Börg. Desm. Brasil. 1890, p. 32, t. 3, f. 13.

Cells with the lateral lobes entire and slightly retuse, polar lobe narrower and more cuneate; cell-wall smooth or punctate.

Length 127–150 μ; breadth 95–100 μ; breadth of polar lobe 53–56 μ; breadth of isthmus 25–34 μ.

England.—Near Stickle Tarn, Westmoreland! New Forest, Hants!

Wales.—Dolgelly, Merioneth!

Scotland.—Moidart, Inverness!

Ireland.—Glenties, Donegal! Ballynahinch, Galway! Lough Fea, Londonderry!

Geogr. Distribution.—Brazil.

6. **Micrasterias conferta** Lund.
(Pl. XLIII, figs. 4–8.)

Micrasterias conferta Lund. Desm. Suec. 1871, p. 14, t. 1, f. 5; Wolle, Desm. U.S. 1884, p. 114, t. 53, f. 12, 13; Cooke, Brit. Desm. 1886, p. 59, t. 28, f. 2; Roy & Biss. Scott. Desm. 1893, p. 173; West & G. S. West, Scott. Freshw. Plankton, I, 1903, p. 525.
M. granulata Wood, Freshw. Alg. N. Amer. 1874, p. 146, t. 21, f. 16.
Helierella conferta Kuntze, Revis. gen. plant. 1891, p. 898.

Cells somewhat small, broadly elliptic, deeply constricted, sinus narrowly linear (often entirely closed by the overlapping of the basal angles of the semicells); semicells five-lobed, with all the lobes and lobules closely approximated, the interlobular incisions being narrowly linear and not very deep; polar lobe subcuneate, dilated from a somewhat narrow base, lateral margins concave, apex convex but retuse in the middle, with two minute papillæ on the apical margin near each of the slightly-obtuse angles, often with a pair of small teeth on each side of the median hollow; lateral lobes about equal in breadth, each divided by a shallow incision into two lobules, lobules again divided, the four ultimate divisions being equal in size and retuse-emar-

ginate (sometimes convex with a median papilla). Side view of semicell rectangular-oblong, apex rounded-truncate and bearing 3 papillæ, sides slightly retuse. Vertical view oblong-lanceolate with a papilla at each pole. Cell-wall minutely punctate.

Zygospore unknown.

Length 84–89 μ; breadth 74–82 μ; breadth of polar lobe 40–44 μ; breadth of isthmus 16–19 μ; thickness 23 μ.

Scotland.—Glen Urquhart, Inverness; Upper Powlair in Birse, Birsemore Loch, Dalwhing near Aboyne, near Loch Dawan, and near Loch Kinord, Aberdeen; Muiryhaugh and Dalbrake in Strachan, Kincardine; Glen Coe, Argyll; North Glen Sannox, Arran (*Roy & Bissett*). Near Stirling! Rhiconich, and plankton of Loch Morar, Sutherland! Near Tarbert and in the plankton of Loch Laxadale, Harris! Near Balallan and in plankton of Loch Mor Bharabhais, Loch Cuthaig, and Loch Fadaghoda, Lewis, Outer Hebrides!

Geogr. Distribution.—France. Norway. Sweden. Finland. Greenland. United States.

This *Micrasterias* is essentially of a northern type and it is one of the rarest British species. In Europe it seems to be almost confined to the north-western countries, and it is met with frequently in the eastern parts of the United States.

It is only known from Scotland in the British Islands, having been found in a number of localities on both the eastern and western slopes. In some parts of the Outer Hebrides it can be obtained frequently, but never in abundance.

M. conferta is a very characteristic species, *M. papillifera* being the only other species of the genus with which it could be confused. It is, however, easily distinguished by the shortness and breadth of the polar lobe, which widens out from a relatively narrow base. The lobes and lobules are more compact and crowded than is generally the case in *M. papillifera*, and the incisions between them are not so deep. The apex of the polar lobe also differs greatly from that of *M. papillifera*, and the interlobular incisions are not bordered by minute spines.

Irregularities in the form of the lobules are of frequent occurrence. The four small lobules of each lateral lobe should

normally be slightly retuse or emarginate, but they are often truncate with a median papilla, or even bluntly triangular. There is also a great tendency for the lateral lobes to grow in size until they not only overlap each other at the sinus, but also overlap the polar lobe on each side.

Var. **hamata** Wolle. (Pl. XLIII, figs. 10, 11.)

M. conferta var. *hamata* Wolle, in Bull. Torr. Bot. Club, 1883, p. 19, t. 27, f. 1; Desm. U. S. 1884, p. 114, t. 53, f. 12, 13; West & G. S. West, Some N. Amer. Desm. 1896, p. 241, t. 14, f. 8, 9.
M. hamata Börg. Desm. Bras. 1890, p. 31.

Lateral lobes as in the typical form, or rarely somewhat further subdivided; polar lobe less widely cuneate, with the lateral angles downwardly uncinate.

Length 80–128 μ; breadth 75–107 μ; maximum breadth of polar lobe 36·5–53 μ; breadth of isthmus 10·5–19 μ.

Scotland.—Plankton of Loch nan Cuinne, Sutherland! (*J. Murray*). Near Tarbert, Harris, Outer Hebrides!

Geogr. Distribution.—United States.

This is a very curious variety of *M. conferta* in which the lateral margins of the polar lobe are greatly excavated just below the angles of the lobe. The lobe is thus more or less anvil-shaped, and the angles are distinctly uncinate. The incisions below the polar lobe are therefore widely open, but closed again at the outer extremity. Specimens of this variety sometimes reach a larger size than is ever attained by the typical form.

We have already pointed out ('Some N. Amer. Desm.,' p. 241) that Börgesen was greatly in error in elevating this variety to the rank of a species. Moreover, the *Micrasterias* which Börgesen figured from Brazil under the name of "*M. hamata* forma *Brasiliensis*" (*vide* Börg. 'Desm. Bras.' t. 2, f. 11) is certainly not a form of *M. conferta* var. *hamata*. We have seen many specimens of *M. conferta* which combined the characters of both the type and the var. *hamata*. Very often the polar lobe of one semicell is typical, whereas that of the other semicell is such as is found in the var. *hamata*. We give a figure of one of these forms which demonstrates conclusively that the var. *hamata* is truly a variety of *M. conferta* and not a distinct species (Pl. XLIII, fig. 9; length 77 μ; breadth 76 μ.)

7. **Micrasterias papillifera** Bréb.

(Pl. XLIV, figs. 1, 2, 7.)

Micrasterias papillifera Bréb. in Ralfs' Brit. Desm. 1848, p. 72, t. 9, f. 1; Arch. in Pritch. Infus. 1861, p. 727, t. 1, f. 18, 19; Rabenh. Flor. Europ. Alg. III, 1868, p. 194; Delp. Desm. subalp. 1873, p. 86, t. 4, f. 5, 6; Kirchn. Alg. Schles. 1878, p. 163; Wolle, Desm. U. S. 1884, p. 109, [t. 32, f. 8, 9?]; Cooke, Brit. Desm. 1886, p. 60, t. 27, f. 2; Hansg. Prodr. Algenfl. Böhm. 1888, p. 210; De Toni, Syll. Alg. 1889, p. 1132; West, Alg. N. Wales, 1890, p. 287; Alg. W. Ireland, 1892, p. 135; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 174; Nordst. Index Desm. 1896, p. 194; West & G. S. West, Alg. S. England, 1897, p. 484; Alga-fl. Yorks. 1900, p. 66; Alg. N. Ireland, 1902, p. 30.

Didymidium (*Micrasterias*) *papilliferum* Reinsch, Algenfl. Frank. 1867, p. 146.

Helierella papillifera Kuntze, Revis. gen. plant. 1891, p. 899.

Cells of moderate size, usually a little longer than broad, subelliptic or subcircular, deeply constricted, sinus very narrowly linear; semicells 5-lobed, with the lobes and lobules usually almost approximate, interlobular incisions linear; polar lobe cuneate with concave sides, apex concave with a slight median notch, each angle slightly produced and furcato-emarginate, with a pair of small teeth on each side of the median notch; lateral lobes cuneate, of almost equal breadth, each divided by a moderately deep incision into two lobules, lobules again divided, the four ultimate divisions of each lobe being emarginate (or rarely tridenticulate). Side view of semicell elliptic-oblong, with a tricuspidate apex. Vertical view narrowly oblong with subacute poles. Cell-wall generally minutely punctate, with a row of acute granules or denticulations on each side of the sinus and the interlobular incisions; in both side and vertical views these granules or small teeth are marginal.

Zygospore globose, furnished with strong processes, each of which is doubly furcate at the apex, the ultimate divisions being small but widely spreading; the processes are one-third the diameter of the zygospore in length.

Length 118–145 μ; breadth 108–145 μ; breadth of polar lobe 35–44 μ; breadth of isthmus 15–22 μ; thickness 21–24 μ; diam. zygosp. without processes

42–44 μ, with processes 67–72 μ; length of processes 15–17·5 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W. and N. Yorks! Lancashire! Warwick (*Wills*). Surrey! (*Ralfs*). Sussex (*Ralfs*). Hants! (*Ralfs*). Devon! Cornwall! (*Ralfs*).

Wales.—Fairly general in the north! Zygospore from Dolgelly, Merioneth (*Ralfs*).

Scotland.—General! Zygospores from Dinnet, Aberdeen, and from Fowlis Wester, Perth (*Roy & Bissett*). Outer Hebrides! Orkneys! Shetlands!

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Antrim!

Geogr. Distribution.—France. Germany. Austria and Galicia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. N. and S. Russia. Russian Lapland. Greenland. New Zealand. United States. Brazil.

This is the most abundant of the smaller British species of the genus which possess deeply-lobed semicells. It is known at once by the form of the polar lobe and by the denticulations bordering the interlobular incisions. It is somewhat variable in its relative proportions. Most specimens are a little longer than broad, but individuals are sometimes met with of equal length and breadth.

M. papillifera cannot be confused with *M. conferta* if the polar lobe is carefully examined. It must likewise be remembered that the latter species is smaller, very much rarer, and more restricted in its distribution.

Some forms occasionally exhibit a roughness on the exterior of the cell-wall somewhat similar to that commonly present on *M. Jenneri*. Cells of this kind are invariably old ones and may exhibit a rather corroded outline. Schmidle ('Beitr. alp. Alg.,' 1896, p. 23 cum fig.) has named forms of this nature which he found in the Austrian Tyrol "var. *verrucosa*."

Forma **major**. (Pl. XLIV, fig. 3.)

Length 200 μ; breadth 170 μ; breadth of polar lobe 51 μ; breadth of isthmus 29 μ.

Wales.—Llyn Ogwen, Carnarvonshire!

Var. **glabra** Nordst. (Pl. XLIV, figs. 4, 5.)

M. papillifera Bréb. var. *glabra* Nordst. in Wittr. & Nordst. Alg. Exsic. 1882, No. 466; in fasc. 21 (1889), p. 35; West Alg. W. Ireland, 1892, p. 135.

Cells destitute of the acute granules or denticulations which are normally present on both sides of the principal incisions.

Length 90–125 μ; breadth 88–109 μ; breadth of isthmus 19 μ.

Scotland.—Near Tarbert, Harris, Outer Hebrides!

Ireland.—Ballynahinch, Galway!

Geogr. Distribution.—N. Russia. Brazil.

A form of this variety was described from the west of Ireland as "var. *glabra* Nordst. forma *inflata* West," in which there was a small basal inflation in the side view of the semicells. This form is figured on Pl. XLIV, fig. 5 (length 125 μ; breadth 125 μ; breadth of isthmus 15 μ; thickness 29 μ). *Consult* West, 'Alg. W. Ireland,' 1892, p. 135, t. 20, f. 10. Nordstedt has suggested that this form is possibly a small specimen of *M. denticulata* var. *notata,* but we do not think so.

Var. **varvicensis** Turner. (Pl. XLIV, fig. 6.)

M. papillifera Bréb. var. *varvicensis* Turner, Desm. Notes, 1893, p. 345, fig. 13.

"A variety with the lobes and lobules incised almost as in *M. Crux-Melitensis.*" The interlobular incisions are considerably more open than in the typical form.

Length 128 μ; breadth 120 μ; breadth of isthmus 26 μ.

England.—Sutton Park, Warwick (*T. Bolton*).

8. **Micrasterias Murrayi** West & G. S. West. (Pl. XLV, figs. 1–3.)

Micrasterias Murrayi West & G. S. West, Scott. Freshw. Plankton, I, 1903, p. 538, t. 15, figs. 1, 2.

Cells of medium size, as broad as long, very deeply constricted, sinus widely open with an acute apex; semicells broadly subsemicircular and deeply 5-lobed,

with the incisions between the lobes widely open and subradial; polar lobe with subparallel sides, suddenly dilated near the apex, which is retusely emarginate, angles emarginate-dentate, with a minute tooth within the apical margin towards each angle; lateral lobes equal, divided into four equal lobules, the median incision being twice the depth of the other two incisions, each lobule emarginate-dentate. Cells with a series of minute teeth or denticulations on each side of the interlobular incisions and the sinus.

Zygospore unknown.

Length 142–151 μ; breadth 142–147 μ; breadth of isthmus 18 μ.

Scotland.—In the plankton of Loch Ruar, Sutherland! (*J. Murray*).

This species occurred in abundance in the plankton of Loch Ruar, the only locality from which it has yet been obtained. Its characters are very constant and do not agree with those of any other described species of the genus. The incisions between the lobes and lobules are all widely open with concave sides, which feature causes them to be widest about the middle. The sinus, which is more open than that of any other incised *Micrasterias*, is one of the most striking characters of the species.

The only species with which it could be confounded are *M. papillifera* Bréb. and *M. Sol* (Ehrenb.) Kütz. (particularly var. *ornata* Nordst.). From *M. papillifera* it is distinguished by the widely-open sinus and incisions, which are also deeper, and by the very different form of the polar lobe. It is distinguished from *M. Sol* by the widely-open sinus and incisions, which are not so deep, and by the absence of the further subdivision of the superior lateral lobes.

M. Murrayi possesses a series of minute denticulations along the margins of the sinus and each of the incisions between the lobes. This character is present in *M. papillifera* and in *M. Sol* var. *ornata*.

Var. **triquetra** West & G. S. West. (Pl. XLV, fig. 4.)

M. Murrayi var. *triquetra* West & G. S. West, Scott. Freshw. Plankton, I, 1903, p. 538, t. 15, f. 3.

Cells triquetrous, triradiate in the vertical view.

Length 163 μ; breadth 151 μ; breadth of isthmus, 16 μ.

Scotland.—In the plankton of Loch Doon, Ayrshire!

This variety is of great interest as only one other triangular form of *Micrasterias* is known to occur, viz. *M. pinnatifida* (Kütz.) Ralfs var. *trigona* West ('Freshw. Alg. Maine,' 1889, p. 206; in 'Journ. Bot.,' 1889, t. 291, f. 15).

9. **Micrasterias Sol** (Ehrenb.) Kütz.

(Pl. XLVI, figs. 1, 2.)

Euastrum Sol Ehrenb., Verbreit. und Einfluss mikroskop. Lebens in Süd- und Nord-amerika, Physik. Abh. Preuss. Ak. Wiss. zu Berlin, 1841 (Berlin, 1843), p. 413, t. 4, f. 16.

Micrasterias radiosa Ralfs, Brit. Desm. 1848, p. 72, t. 8, f. 3; Arch. in Pritch. Infus. 1861, p. 727, t. 1, f. 21; Rabenh. Flor. Europ. Alg. III, 1868, p. 192; Delp. Desm. subalp. 1873, p. 85, t. 4, f. 2–4; Wolle, Desm. U.S. 1884, p. 109, t. 31, f. 2, 3 [figures bad]; Cooke, Brit. Desm. 1886, p. 59, t. 27, f. 1; De Toni, Syll. Alg. 1889, p. 1133; West, Alg. W. Ireland, 1892, p. 134; Roy & Biss. Scott. Desm. 1893, p. 174; Nordst. Index Desm. 1896, p. 219; West & G. S. West, Alg. S. England, 1897, p. 484; Scott. Freshw. Plankton, I, 1903, p. 525.

M. Sol (Ehrenb.) Kütz. Spec. Alg. 1849, p. 171; Jacobs. Desm. Danem. 1875, p. 188.

Helierella Sol (Ehrenb.) Kuntze Rev. gen. plant. 1891, p. 897.

Cells approximately circular in outline, very deeply constricted, sinus slightly open with each margin faintly 2- or 3-undulate; semicells deeply 5-lobed, with the incisions between both the lobes and lobules deep and slightly open, sometimes open inwards but closed outwards; polar lobe with subparallel sides, slightly expanded at the apex, apical margin retuse-emarginate, each angle emarginate-dentate, with a small tooth attached within the apical margin near the angle on each side; lateral lobes unequal, superior lateral lobes slightly larger than inferior lateral lobes and generally (but not always) more subdivided; inferior lateral lobes divided into four equal lobules by three incisions, the median one being much deeper than the other two, each lobule furcate-dentate at the extremity (or sometimes further divided into two furcate-dentate portions of equal size); superior lateral

lobes divided into eight equal lobules by seven incisions of which the median one is much the deepest, each lobule furcate-dentate at its extremity; margins of interlobular incisions generally slightly undulate like the sinus. Side view of semicell linear-oblong, very gradually attenuated to a tridentate apex. Vertical view linear-fusiform, with acute poles and a slight flattened protuberance in the middle on each side. Cell-wall delicately punctate.

Zygospore unknown.

Length 162–191 μ; breadth 158–192 μ; breadth of polar lobe (at apex) 36–38 μ; breadth of isthmus 17–18 μ.

England.—Bowness, Westmoreland! Near Chapel Wood, S.E. Surrey! Cornwall (*Marquand*).

Wales.—Capel Curig, Carnarvonshire (*Cooke & Wills*)! Llyn Gwernan near Dolgelly, Merioneth (*Ralfs*).

Scotland.—Slewdrum, Aboyne and Birsemore Lochs, Aberdeen (*Roy & Bissett*). Rhiconich, and in the plankton of Lochs Shin, Ghriama, and nan Cuinne, Sutherland! Plankton of Loch Fadaghoda, Lewis; near Tarbert, Harris; and in the plankton of Loch nan Eun, N. Uist, Outer Hebrides! Plankton of Loch Beosetter, Bressay, Shetlands!

Ireland.—Lough Derryclare, Galway! Adrigole, Kerry!

Geogr. Distribution.—France. Italy. Sweden. Denmark. United States. Jamaica. Brazil.

This is one of the most beautiful species of the genus and has been recorded principally under the name of "*Micrasterias radiosa*." The first recognizable mention of this *Micrasterias* is that by Ehrenberg in 1843 under the name of *Euastrum Sol.*

Neither *Echinella radiosa* Acharius (in Weber and Mohr, 'Beitr. zur Naturkunde,' II, 1810, p. 340, t. 4, f. 4–15), nor *Echinella radiosa* Lyngbye ('Tantamen Hydrophyt. Danicæ,' etc., Hafniæ, 1819, p. 208, t. 69, f. E) refer to anything of the nature of a *Micrasterias* as the genus is at present understood. *Micrasterias radiosa* Ag. (in 'Flora,' 1827, p. 643) is simply a

name which the author gave to *Echinella radiosa* Lyngbye. *Micrasterias radiosa* Ralfs ('Brit. Desm.' 1848, p. 72, t. 8, f. 3) which that author wrongly attributed to Agardh, is the first good account of the Desmid described and figured by Ehrenberg five years previously (1843) under the name of "*Euastrum Sol.*" Ralfs himself recognized this identity and placed *Euastrum Sol* Ehrenb. as a synonym of his *Micrasterias radiosa*. The specific name "*Sol*" must therefore take precedence over Ralfs' name "*radiosa*."

Micrasterias Sol is almost circular in outline, and is easily distinguished by the depth and elegance of its lobulation. The margins of the deeper incisions are usually slightly undulate and the lobules frequently overlap.

North American specimens of this species exhibit much greater variation than is shown in British examples.

Var. **ornata** Nordst. (Pl. XLVI, figs. 3, 4.)

Micrasterias radiosa Ralfs var. *ornata* Nordst. Desm. Brasil, 1870, p. 223, t. 2, f. 11; Lund. Desm. Suec. 1871, p. 13; Roy & Biss. Scott. Desm. 1893, p. 174; West & G. S. West, Some N. Amer. Desm. 1896, p. 240.
M. Sol (Ehrenb.) Kütz. var. *ornata* Nordst. in Pointsför. Skand. Växt. iv, 1880, p. 25.

With a row of minute teeth or denticulations on each side of the sinus and of the incisions between the five lobes of the semicells.

Length 112–188 μ; breadth 110–171 μ; breadth of isthmus 16–18 μ; thickness 22 μ.

Wales.—Capel Curig, Carnarvonshire!

Scotland.—Near Brin, Inverness; Slewdrum and near Craigendinnie Farm, Aberdeen; Scolty Dam, Kincardine (*Roy & Bissett*). Plankton of Loch Doon, Ayrshire! Plankton of Loch Fadaghoda, Lewis, Outer Hebrides!

Geogr. Distribution.—Norway. United States. Brazil.

10. **Micrasterias apiculata** (Ehrenb.) Menegh. (Pl. XLVII, figs. 1, 2.)

Euastrum apiculatum Ehrenb., 1834; Infus. 1838, p. 161, t. 12, f. II.
Micrasterias apiculata (Ehrenb.) Menegh. Synops. Desm. 1840, p. 216;

Ralfs, Brit. Desm. 1848, p. 209; Arch. in Pritch. Infus. 1861, p. 727; Rabenh. Flor. Europ. Alg. III, 1868, p. 193; Kirchn. Alg. Schles. 1878, p. 163; Roy & Biss. Jap. Desm. 1886, p. 193, t. 268, f. 13; Cooke, Brit. Desm. 1887, p. 186, t. 48, f. 1; Nordst. Bornh. Desm. 1888, p. 187; Heimerl, Desm. alp. 1891, p. 602; West & G. S. West, Some N. Amer. Desm. 1896, p. 240; Nordst. Index Desm. 1896, p. 48.

Didymidium (*Micrasterias*) *apiculatum* Reinsch, Algenfl. Frank. 1867, p. 145.

Micrasterias fimbriata Ralfs forma *apiculata* Wolle, Desm. U. S. 1884, p. 110.

Helierella apiculata Kuntze, Rev. gen. plant. 1891, p. 898.

Cells large, a little longer than broad, subelliptic in outline, very deeply constricted, sinus widely open outwards but linear towards its apex; semicells 5-lobed; polar lobe distinctly exserted, lower portion with subparallel sides, upper portion widely dilated, apex retuse-emarginate, angles with a pair of diverging spines and with a large curved spine on the apical margin close to each angle, and with a pair of spines on each side of the apical notch; lateral lobes subequal, bilobulate, lobules again divided and each division furnished with two (sometimes three) marginal curved spines; incisions bordering the polar lobes opening widely outwards, the remaining incisions (both primary and secondary) more or less open. Side view narrowly ovate-pyramidate with a truncate apex bearing spines. Vertical view rhomboid-elliptic with acute poles. Cell-wall furnished with numerous minute spines, arranged in subradiate rows or scattered over the surface, with four rather larger spines arranged in a quadrate manner in the middle of each semicell just above the isthmus.

Zygospore unknown.

Length 220–294 μ; breadth 180–250 μ; breadth of isthmus 30–36 μ.

England.—Bowness, Westmoreland (*Turner*).

Geogr. Distribution.—France. Germany. Galicia in Austria. Italy. Sweden. Denmark. Bornholm. Finland. Poland. Russia. Japan. India. Burma. United States.

This beautiful species in its typical form is only known from the English Lake District, having been found by Turner in a locality which furnishes numerous specimens of

several of its varieties. It can be at once recognized by the numerous spines inserted regularly on the margins of the lobules and polar lobe, and more or less irregularly all over the surface of the cell. It is somewhat variable in its relative proportions.

Var. **fimbriata** (Ralfs) Nordst. (Pl. XLVI, fig. 6; Pl. XLVII, figs. 3, 4.)

Euastrum Rota Ehrenb. Infus. 1838 (in part), t. 12, f. I *d*.
Micrasterias fimbriata Ralfs, Brit. Desm. 1848, p. 71, t. 8, f. 2; Arch. in Pritch. Infus. 1861, p. 727; Rabenh. Flor. Eur. Alg. III, 1868, p. 193; Kirchn. Alg. Schles. 1878, p. 162; Wolle, Desm. U. S. 1884, p. 109, t. 36, f. 1–8 (various forms); Cooke, Brit. Desm. 1886, p. 59, t. 26, f. 1; Wolle, Freshw. Alg. U. S. 1887, p. 338; Hansg. Prodr. Algenfl. Böhm. 1888, p. 210; De Toni, Syll. Alg. 1889, p. 1131; Roy & Biss. Scott. Desm. 1893, p. 174; Nordst. Index Desm. 1896, p. 124.
Didymidium (*Micrasterias*) *fimbriatum* Reinsch. Algenfl. Frank. 1867, p. 149.
Micrasterias apiculata (Ehrenb.) Menegh. subsp. *fimbriata* Nordst. Bornh. Desm. 1888, p. 190; West, Alg. Eng. Lake Distr. 1892, p. 722; Nordst. Index Desm. 1896, p. 48; West & G. S. West, Alga-fl. Yorks. 1900, p. 66.
Helierella fimbriata Kuntze, Revis. gen. plant. 1891, p. 898.

Interlobular incisions narrower than in the type, causing the lateral and polar lobes to become approximate; polar lobe less projecting, usually with fewer apical spines; cell-wall commonly destitute of surface-spines.

Zygospore globose, furnished with slender, elongate, scattered spines, mostly furcate at their extremities and sometimes notched below the middle; furcate extremities with the divisions recurved.

Length 230–255 μ; breadth 216–245 μ; breadth of isthmus 29–32 μ; diam. of zygospore without spines 75 μ, with spines 125 μ.

England.—Bowness, Westmoreland! Cullingworth, Adel Dam, and Eldwick, W. Yorks! Sutton Park, Warwick (*Wills*).

Wales.—Capel Curig, Carnarvonshire (*Cooke & Wills*). Dolgelly, Merioneth (*Ralfs*).

Scotland. — Scotston Moor, near Kintore, Presswhin, Loch Ullachie, and near Ballater, Aberdeen; near Bridge of Feugh, Kincardine; Menmuir, Forfar (*Roy & Bissett*). Rhiconich, Sutherland! Plankton of Loch nan Cuinne, Sutherland! (*J. Murray*).

Ireland.—Dublin and Wicklow (*Archer*). Clough, Antrim!

Geogr. Distribution.—France. Belgium. Germany. Galicia in Austria. Norway. Sweden. Denmark. N. and S. Russia. United States.

Var. **fimbriata** forma **spinosa** Bissett. (Pl. XLVII, fig. 5.)

M. fimbriata Ralfs var. *spinosa* Bissett in Roy & Biss. Scott. Desm. 1893, p. 174, t. 4, f. 3.

Cell-wall furnished with a row of minute spines along each side of the principal incisions, three or four close to the base of each semicell, and a row of about four under the base of the polar lobe.

Length 210 μ; breadth 200 μ; breadth of isthmus, 25 μ.

Scotland.—Slewdrum, Loch Ullachie and marsh west of it, Aberdeen (*Roy & Bissett*).

M. apiculata var. *fimbriata*, although a scarce Desmid, is more often met with than any of the other forms of *M. apiculata*. It is exceedingly variable in the form of the lobules, especially those of the inferior lateral lobes nearest the sinus, which often project considerably beyond the general contour of the cell. The polar lobe is also variable in the amount of its exsertion, sometimes projecting considerably beyond the superior lateral lobes, sometimes not projecting in the least degree. The insertion of the marginal spines is precisely similar to that in typical *M. apiculata*. Most forms of *M. apiculata* var. *fimbriata* are usually destitute of surface-spines, but many intermediate stages are met with between such forms and the thickly-spined form of *M. apiculata* itself. In some the surface-spines are scattered and few in number, in others they are irregularly disposed in the neighbourhood of the principal incisions, and in others they are more numerous and more regularly arranged. The latter form was named by Bissett "*f. spinosa*."

The zygospore is recorded from Rochester, New Hampshire, U.S.A., by Wolle.

Var. **brachyptera** (Lund.) *nob.* (Pl. XLVI, fig. 5; Pl. XLVII, figs. 6, 7.)

M. brachyptera Lund. Desm. Suec. 1871, p. 12, t. 1, f. 4; Wolle, Desm. U.S. 1884, p. 110, t. 32, f. 6, 7; Biss. Desm. Windermere, 1884, p. 192; Cooke, Brit. Desm. 1886, p. 63, t. 30, f. 2; De Toni, Syll. Alg. 1889, p. 1120.
M. brachyptera forma *bispinata* Turn. New and Rare Desm. 1885, p. 937, t. 16, f. 15.
M. apiculata (Ehrenb.) Menegh. subsp. *fimbriata* γ *brachyptera* Nordst. Bornh. Desm. 1888, p. 190.
Helierella brachyptera Kuntze, Revis. gen. plant. 1891, p. 898.

Proportionately longer than the type; polar lobe *more projecting*, relatively larger and *wider*, with a distinct constriction below the apex, apical margin widely retuse; lateral lobes *shorter* and generally with fewer lobulations; sinus and incisions between the lobes widely open, especially the incisions between the polar lobe and the superior lateral lobes; generally with a row of spines bordering each side of the polar lobe and the sinus. Cell-wall punctate.

Length 191–230 μ; breadth 131–180 μ; breadth of isthmus 34–37 μ; max. breadth of polar lobe 54–60 μ; thickness 72 μ.

England.—Bowness, Westmoreland! (*Bissett*).

Scotland.—Loch Ness, Inverness! Rhiconich, Sutherland! Plankton of Loch Fadaghoda, Lewis, Outer Hebrides!

Geogr. Distribution.—Norway. Sweden. Poland (form). S. Russia. United States.

This is a well-marked variety of *M. apiculata* differing in its shorter lateral lobes, wider and more outstanding polar lobe, and in the fewer number of surface-spines. The insertion of the marginal spines is exactly similar to that of all other forms of *M. apiculata*, and the lobulation of the lateral lobes and number of inserted spines is very variable, the two semicells of one individual often differing considerably in these respects. There is thus no reason for Turner's name "forma *bispinata*." Most specimens of this variety possess a row of spines within each side of the polar lobe and within each margin of the sinus. The number of these spines is variable and in some specimens they are entirely wanting.

The latter forms have been termed by Nordstedt "forma *glabriuscula*" (*vide* Pl. XLVII, fig. 7). The lateral lobes in some forms are widely separated and spreading, but in others they are more compact and the incision between them is narrow.

11. **Micrasterias rotata** (Grev.) Ralfs.

(Pl. XLVIII, figs. 1–6.)

Micrasterias furcata Ag. in Flora, 1827, p. 643 [Description bad and quite unrecognizable; Agardh's original specimens have been found to be partly *M. rotata*].

? *Euastrum Rota* Ehrenb. Entwick. Lebends. d. Infus. 1832, p. 82 [Description bad and too brief]; Ehrenb. Infus. 1838, p. 161, t. 12, f. 1 [Figures include *M. rotata*, *M. apiculata* var. *fimbriata*, and *M. truncata*].

Echinella rotata Grev. in Hooker's Brit. Fl. 1833, II, p. 398.

Cosmarium stellinum Corda in Alm. de Carlsbad, 1834, p. 180.

Eutomia rotata Harv. Man. Brit. Alg. 1841, p. 187.

Micrasterias rotata (Grev.) Ralfs in Ann. Mag. Nat. Hist. 1844, p. 259, t. 6, f. 1; Hass. Brit. Freshw. Alg. 1845, p. 385, t. 90, f. 1; Ralfs, Brit. Desm. 1848, p. 71, t. 8, f. 1 *a* (and *b* ?); Arch. in Pritch. Infus. 1861, p. 727, t. 1, f. 20; in Quart. Journ. Micr. Sci. 1868, p. 294; Rabenh. Flor. Europ. Alg. III, 1868, p. 108 cum fig. xylogr.; Lund. Desm. Suec. 1871, p. 12; Delp. Desm. subalp. 1873, p. 82, t. 4, f. 1; Kirchn. Alg. Schles. 1878, p. 162; Wolle, Desm. U.S. 1884, p. 109, t. 34, f. 1, 2; Cooke, Brit. Desm. 1886, p. 57, t. 24; Hansg. Prodr. Algenfl. Böhm. 1888, pp. 209, 253; De Toni, Syll. Alg. 1889, p. 1126; West, Alg. N. Wales, 1890, p. 286; Alg. W. Ireland, 1892, p. 134; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 174; Nordst. Index Desm. 1896, p. 226; West & G. S. West, Desm. Singapore, 1897, p. 163; Alg. S. England, 1897, p. 484; Alga-fl. Yorks. 1900, p. 66; Alg. N. Ireland, 1902, p. 30; Scott. Freshw. Plankton, I, 1903, p. 525.

Didymidium (*Micrasterias*) *rotatum* Reinsch, Algenfl. Frank. 1867, p. 149.

Helierella rotata Kuntze, Revis. gen. plant. 1891, p. 899.

Micrasterias rotata var. *acutidentata* Benn. Freshw. Alg. S.W. Surrey, 1892, p. 9, t. 2, f. 10 [Figure incorrect].

Cells large, a little longer than broad, subcircular in outline, very deeply constricted, sinus narrowly linear; semicells 5-lobed, interlobular incisions narrowly linear; polar lobe gradually widening upwards, with concave sides, often slightly projecting, apex retuse-emarginate, angles slightly produced and bidentate; lateral lobes unequal and broadly cuneate, each divided into two lobules by a deep incision; superior lateral lobes larger than inferior lobes, each lobule subdivided into four equal emarginate (or bidentate) parts by three incisions, the median one being the deepest; lobules of inferior lateral lobes divided into two (sometimes four)

bidentate (rarely tridentate) parts. Side view of semicell ovate-lanceolate, with a broadly truncate apex and an inflated base. Vertical view narrowly elliptic-rhomboid, with acute poles and a small inflation in the middle of each side. Cell-wall delicately punctate.

Zygospore globose, furnished with many strong, elongate, simple spines.

Length 208–366 μ; breadth 165–305 μ; breadth of isthmus 29–43 μ; breadth (maximum) of polar lobe 48–80 μ; diam. zygospore without spines 108 μ, with spines 158 μ.

England.—Cumberland ! Westmoreland (up to 2,400 ft. on Helvellyn) ! (*Ralfs*). W. and N. Yorks ! Lancashire ! Leicestershire (*Roy*). Warwick (*Wills*). Gloucestershire (*Ralfs*). Wilts ! Surrey ! (*Ralfs*). Sussex (*Ralfs*). Kent ! (*Ralfs*). Hants ! (*Bennett*). Devon ! (*Bennett*). Cornwall ! (*Ralfs*).

Wales.—Capel Curig ! (*Cooke & Wills*), Llyn Padarn ! Llyn Idwal !, Y Foel Fras !, Carnarvonshire. Glamorganshire !

Scotland.—General ! Zygospores from Slewdrum, Aberdeen ; near Bishop's Dam, Kincardine ; Monroman Moor, Forfar (*Roy & Bissett*). Occasional in the plankton ! Outer Hebrides ! Shetlands !

Ireland.—General, but scarce ! Zygospores from Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Austria. Galicia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. Poland. S. and Central Russia. Japan. India. Siam. Singapore. United States. Brazil.

M. rotata is not a common species, although very widely distributed. It is easily distinguished from *M. denticulata* by the emarginate-dentate lobules and by the polar lobe, which is slightly exserted and furnished with bidentate angles.

The principal variation is in the polar lobe, especially in the amount of its exsertion. Sometimes the incisions on each side of the polar lobe are more or less open, and

its angles may be produced to form very short bidentate processes.

The inferior lateral lobes occasionally possess the same number of ultimate lobules as the superior lateral lobes, and in more normal specimens in which the inferior lateral lobes are only subdivided into four divisions, some or all of these divisions are sometimes tridentate.

Forma **granulata** West.

M. rotata forma *granulata* West, Alg. W. Ireland, 1892, p. 134.

Cell-wall distinctly granulate, granules flattened and irregularly scattered.

Ireland.—Lough Aunierin, Galway!

Forma **evoluta** Turn.

M. rotata forma *evoluta* Turn. Freshw. Alg. E. India, 1893, p. 167, t. 23, f. 1.

M. rotata var. *pulchra* Lemm. Zweiter Beiträg zur Algenflora des Plöner Seengebietes, Forschungsberichte Biol. Stat. Plön, iv, 1896, p. 173, fig. 7.

Incisions between the lobes and lobules more open than in the type; polar lobe furnished with a pair of small teeth on the apical margin on each side of the median emargination.

Length 270–282 μ; breadth 220–262 μ.

Scotland.—Sligachan in Skye, Inverness!

Geogr. Distribution.—Germany. India.

The polar lobe of this form may or may not be exserted, and the cell-wall is sometimes strongly punctate.

Var. **urnigera** Bennett.

M. rotata var. *urnigera* Benn. Freshw. Alg. Hamps. and Devon, 1890, p. 6, t. 1, f. 9.

Slightly larger than the type; polar lobe "urn-like" and projecting for a distance of 25 μ.

Length (including projecting polar lobe) 325 μ; breadth 250 μ.

England.—Lyndhurst, Hants (*Bennett*).

We are unacquainted with this variety, and have not reproduced Bennett's figure, as it is too much of a caricature.

12. **Micrasterias denticulata** Bréb.

(Pl. XLIX, figs. 1–7; Pl. L, figs. 1, 2.)

Micrasterias denticulata Bréb. Alg. Falaise, 1835, p. 54, t. 8; Ralfs, Brit. Desm. 1848, p. 70, t. 7, f. 1; De Bary, Conj. 1858, p. 41; Arch. in Pritch. Infus. 1861, p. 727, t. 2, f. 22; in Quart. Journ. Micr. Sci. 1867, p. 296; *l. c.* 1868, p. 294; Rabenh. Flor. Europ. Alg. III, 1868, p. 108, cum fig. xylogr.; Lund. Desm. Suec. 1871, p. 12; Jacobs. Desm. Danem. 1875, p. 186, t. 7, f. 11, t. 8, f. 1; Kirchn. Alg. Schles. 1878, p. 162; Gay, Monogr. loc. Conj. 1884, p. 52, t. 1, f. 2, 3; Wolle, Desm. U. S. 1884, p. 109, t. 34, f. 4–8 [forms]; Cooke, Brit. Desm. 1886, p. 56, t. 22; Hansg. Prodr. Algenfl. Böhm. 1888, p. 209; De Toni, Syll. Alg. 1889, p. 1130; West, Alg. N. Wales, 1890, p. 286; Alg. W. Ireland, 1892, p. 134; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 174; Nordst. Index Desm. 1896, p. 99; West & G. S. West, Alg. S. England, 1897, p. 484; G. S. West, Variation Desm. 1899, p. 384; West & G. S. West, Alga-fl. Yorks. 1900, p. 66; Alg. N. Ireland, 1902, p. 30.

Didymidium (*Micrasterias*) *denticulatum* Reinsch, Algenfl. Frank. 1867, p. 147.

Micrasterias furcata Ag. var. *denticulata* Rabenh. Flor. Europ. Alg. III, 1868, p. 192.

Helierella denticulata Kuntze, Revis. gen. plant. 1891, p. 898.

Cells large, about $1\frac{1}{6}$ times longer than broad, broadly elliptic in outline, deeply constricted, sinus narrowly linear; semicells 5-lobed, interlobular incisions narrowly linear; polar lobe narrowly cuneate, with dilated apex and concave sides, not projecting beyond the lateral lobes, apical margin retuse with a widely-open notch in the centre, angles obtuse or sometimes truncate emarginate; lateral lobes almost equal and broadly cuneate, superior lateral lobes sometimes a little larger than inferior ones, divided into two lobules by a deep incision, each lobule further divided into four (sometimes only two) subequal, retuse or emarginate parts. Side view of semicell narrowly pyramidate, with a marked protuberance on each side near the base. Vertical view fusiform, poles acutely conical, with three undulations at the middle on each side. Cell-wall delicately or sometimes coarsely punctate.

Zygospore globose, furnished with scattered, elongate, stout spines with bifid and trifid apices, some of which sometimes divide again and become recurved.

Length 205–350 μ; breadth 177–277 μ; breadth of

isthmus, 23–40 μ; breadth (maximum) of polar lobe 55–75 μ; thickness 55–60 μ; diam. of zygospore without spines 80–116 μ, with spines 170–195 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W. and N. Yorks! Lancashire! Cheshire (*Roy*). Leicestershire (*Roy*). Warwick (*Wills*). Gloucestershire (*Ralfs*). Wilts! Surrey (zygospores from Thursley Common)! Sussex (*Ralfs*). Kent! (*Ralfs*). Hants! (*Ralfs*). Devon! (*Bennett*). Cornwall! (*Ralfs*); zygospores from Halgavor Moor!

Wales.—General! Up to 2,200 ft. on Glyder Fach, Carnarvonshire!

Scotland. — General! (*Roy & Bissett*). Up to 3,500 feet on Lochnagar! Scarce in the plankton! Outer Hebrides! Shetlands!

Ireland.—General!

Geogr. Distribution.—France. Germany. Austria. Galicia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. N., Central, and S. Russia. Faeroes. Greenland. Japan. India. Sumatra. Australia. New Zealand. United States. Brazil.

M. denticulata is a common British species, and is more often met with than any other species of the genus except *M. truncata*, the latter being more plentiful at elevations of 1,000 feet and upwards. It can sometimes be obtained in pure gatherings in small boggy ditches or at a boggy spring. Such pure collections we have made at Eldwick and Adel in W. Yorkshire.

The ordinary form of *M. denticulata* is a little smaller than *M. rotata*, the lateral lobes are more equal and equally lobed, and their ultimate subdivisions are truncate-emarginate and not bidentate. The polar lobe is not exserted beyond the periphery of cell as in *M. rotata*, is more cuneate in shape, with a deeper median notch, and possesses rounded or rounded-truncate angles. In the side-view of the semicell *M. rotata* is stouter and more turgid than *M. denticulata*, and in the vertical view it is also stouter with a solitary rounded protuberance on each side, whereas *M. denticulata* is more slender in vertical view and possesses three less-elevated protuberances at the middle on each side.

Var. **angulosa** (Hantzsch) West & G. S. West. (Pl. L, figs. 3, 4.)

Micrasterias angulosa Hantzsch in Rabenh. Alg. no. 1407, 1862; Nordst. Desm. Grönl. 1885, p. 10; Cooke, Brit. Desm. 1886, p. 62, t. 29; Nordst. Freshw. Alg. N. Zeal. and Austral. 1888, p. 29, 78; De Toni, Syll. Alg. 1889, p. 1133; Roy & Biss. Scott. Desm. 1893, p. 172, t. 4, f. 2.
Didymidium (*Micrasterias*) *angulosum* (Hantzsch) Reinsch, Algenfl. Frank. 1867, p. 147, t. 8, f. 2.
Helierella angulosa Kuntze, Revis. gen. plant. 1891, p. 898.
Micrasterias denticulata Bréb. var. *angulosa* (Hantzsch) W. & G. S. West, Alg. N. Ireland, 1902, p. 30.

Cells more angular than in the type, often relatively broader near the poles; lateral lobes only divided by primary and secondary incisions, the four subdivisions being truncate with rounded angles, retuse, or retuse-emarginate. Cell-wall distinctly and densely punctate.

Zygospore very similar to that of the type.

Length 210–282 μ; breadth 184–230 μ; breadth of isthmus 30–33 μ; thickness 54 μ; diam. of zygospore without spines 114–116 μ; length of spines 32 μ.

England.—Westmoreland! (*Bissett*). Lancashire! W. Yorks! Warwick (*Wills*). Thursley Common, Surrey! Hants! (*Roy*). Cornwall (*Marquand*).

Wales.—Capel Curig (*Cooke & Wills*) and Rhyddu!, Carnarvonshire.

Scotland.—Sutherland!, Ross!, Inverness, Aberdeen, Kincardine, Forfar!, Perth!, Argyll; zygospores from Slewdrum, Aberdeen (*Roy & Bissett*).

Ireland.—Lough Akibbon, Donegal! Near Oughterard, Galway! Slieve Donard, Down! Dublin, Wicklow, and Westmeath (*Archer*).

Geogr. Distribution.—France. Germany. Galicia in Austria. Norway. Sweden. Denmark. Bornholm. Greenland. New Zealand.

This variety has been regarded by some authors as a species, but the distinctions between it and *M. denticulata* are too slight and variable to warrant this separation. It only differs from typical *M. denticulata* in the angularity of the lateral lobes, which are not subdivided to so great an extent. The ultimate divisions of these lobes are also more rounded, but this feature is a very variable one.

Var. **angusto-sinuata** Gay. (Pl. L, fig. 5.)

M. denticulata var. *angusto-sinuata* Gay, Monogr. loc. Conj. 1884, p. 52, t. 1, f. 4; West, Alg. Eng. Lake Distr. 1892, p. 722.

Cells more angular than in the type, with *all the incisions closed and very narrow*; subdivisions of lateral lobes variable, generally retuse and rounded.

Length 260 μ: breadth 186 μ; breadth of isthmus 30 μ.

England.—Loughrigg, Westmoreland!

Scotland.—New Galloway, Kirkcudbright!

Geogr. Distribution.—France.

This variety should perhaps be placed as a synonym of var. *angulosa*. It includes those angular forms in which the incisions are closed and linear. It is no doubt much more generally distributed than is indicated by the localities, but has been overlooked.

Var. **notata** Nordst. (Pl. L, fig. 6.)

M. denticulata var. *notata* Nordst. in Bot. Notiser, 1887, p. 155; Freshw. Alg. N. Zeal. 1888, p. 29, t. 2, f. 13; Roy and Biss. Scott. Desm. 1893, p. 174; West & G. S. West, Alga-fl. Yorks. 1900, p. 67.

Polar lobe with a pair of small teeth on each side of the median notch; semicells from the vertical view with slightly-undulate margins and with a prominent, somewhat acute papilla at the middle on each side.

Length 232–282 μ; breadth 200–220 μ; thickness 74 μ.

England.—Terrington, N. Yorks!

Scotland.—Not uncommon (*Roy & Bissett*). Sutherland!

Geogr. Distribution.—Germany. Sweden. Finland. New Zealand.

This variety may also have a much wider distribution than is here indicated.

Var. **subnotata** West. (Pl. L, fig. 7.)

M. denticulata var. *subnotata* West, Alg. Eng. Lake Distr. 1892, p. 722, t. 9, f. 5.

Polar lobe with a small tooth on each side of the

median notch; semicells in vertical view lanceolate-fusiform, with acuminate poles, and a broad, rounded-conical elevation at the middle on each side.

Breadth 170 μ; thickness 50 μ.

England.—Bowness, Westmoreland!

Note.—In Cooke's 'British Desmids' on Pl. XLVII is figured (fig. 5) "*M. denticulata* var. *licmoides* Wills," but no description of this form is given. It has both polar lobe and lateral lobes much reduced, and appears to us to be merely a monstrosity produced by rapid cell-division. Imperfectly developed semicells lobed in the manner of "var. *licmoides*" are not uncommonly met with in collections containing large numbers of *M. denticulata*.

M. denticulata var. *intermedia* Bennett ('Freshw. Alg. Hamps. and Devon.' 1890, p. 6, t. 1, f. 8) is a doubtful form, so imperfectly described and badly figured that it is quite impossible to identify it. There is, moreover, a var. *intermedia* of this species described by Nordstedt (in Wittr. & Nordst. 'Alg. Exsic.' 1880, no. 370).

13. **Micrasterias verrucosa** Bissett.

(Pl. LI, fig. 2.)

Micrasterias verrucosa "Roy" in Wolle, Bull. Torr. Bot. Club, 1885, p. 127, t. 51, f. 10; Wolle, Freshw. Alg. U.S. 1887, p. 41, t. 59, f. 10; Bissett in Roy and Biss. Scott. Desm. 1893, p. 174, t. 1, f. 2 ["Bissett" stated to be the author of the species].

Cells large, about $1\frac{1}{5}$ times longer than broad, octangularly elliptic, very deeply constricted, sinus narrowly linear; semicells 5-lobed, incisions narrowly linear; lateral lobes somewhat unequal and broadly cuneate, upper ones slightly broader than lower ones; lobulation similar to that of *M. denticulata*, ultimate divisions more rounded in the upper lateral lobes than in the lower ones; polar lobe similar to that of *M. denticulata*. Vertical view linear-oblong, with acute poles and deeply undulate sides. Cell-wall of a brownish colour, with numerous small subgranulate protuberances scattered over its surface; the three largest in a transverse row near the median base of

the semicells are minutely lobed (or granulated); with about four smaller and somewhat indistinct protuberances completing the transverse row across the base of the semicell; four smaller protuberances are also subradiately disposed on the polar lobe, five on each of the upper lateral lobes, and two on each of the lower lateral lobes, but the number of these protuberances is subject to variation.

Zygospore unknown.

Length 210 μ; breadth 180 μ; breadth of isthmus 29 μ.

Scotland.—Collieston, Bennachie, Powlair in Birse, Slewdrum, Aboyne, Birsemore Loch, Moss of Logie, Morven, and Dalbagie, Aberdeen; Craithes near Kerloch, Kincardine (*Roy & Bissett*). Loch Ness, Inverness! (*J. Murray*).

Geogr. Distribution.—United States.

We have not seen this species, but Mr. James Murray submitted a drawing for our inspection of a specimen of *Micrasterias* from Loch Ness which could certainly be referred to *M. verrucosa*.

Roy and Bissett state that "it is not granulated in the ordinary sense; the prominences seem flattened, and their margins cut into rounded segments, similar to the stigma of a species of *Poppy*, only more deeply cut."

14. **Micrasterias Thomasiana** Arch.

(Pl. LI, figs. 3–6.)

Micrasterias Thomasiana Arch. Description of a new Species of Micrasterias, etc., Proc. Dubl. Nat. Hist. Soc. 1862, p. 72, t. 2, f. 1–5; Journ. Micr. Soc., new ser., II, 1862, p. 239, t. 12, f. 1–5; Rabenh. Flor. Europ. Alg. III, 1868, p. 192; Joshua in Journ. Bot. 1882, p. 301; Cooke, Brit. Desm. 1886, p. 58, t. 25, f. 1 (in part); West, Alg. W. Ireland, 1892, p. 134; Alg. Eng. Lake District, 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 174; Nordst. Index Desm. 1896, p. 254; West & G. S. West, Desm. Singapore, 1897, p. 163; Alg. S. England, 1897, p. 484; G. S. West, Variation Desm. 1899, p. 384, t. 9, f. 6-8; West & G. S. West, Alga-fl. Yorks. 1900, p. 67; Alg. N. Ireland, 1902, p. 30.

M. denticulata Bréb. forma *Thomasiana* Jacobs. Desm. Danem. 1875, p. 187.

Helierella Thomasiana Kuntze, Revis. gen. plant. 1891, p. 899.

Cells rather large, suborbicular, very deeply constricted, sinus narrowly linear; semicells 5-lobed,

incisions between the lobes very narrow and linear; polar lobe narrowly cuneate with concave sides, not projecting, apical margin generally slightly retuse, with a fairly deep median notch, angles on each side of median notch apiculate, outer angles commonly emarginate (sometimes only apiculate); lateral lobes fairly equal and broadly cuneate, with a deep and linear primary incision dividing each lobe into two equal lobules, each lobule with a secondary incision (not very deep) and generally with two tertiary incisions, four ultimate divisions of each lobule emarginate or bidentate (sometimes the tertiary divisions are absent so that each lobule is only subdivided into two parts, which are then tridentate or quadridentate); with three projections across the base of the semicells, the middle one conical and rounded or apiculate, the lateral ones attenuated and elongate, *curved outwards*, and emarginate or bidentate at their apices; with a conical tooth within the base of each lateral lobe and one within the base of each lateral lobule, also with two, one above the other, within the lower half of the polar lobe, all these teeth being directed outwards. Side view of semicell narrowly pyramidate, with a rounded basal inflation on each side, apex truncate, lateral margins each with two outwardly-directed, acute projections. Vertical view fusiform, poles acute, with three projections on each side towards the middle, the median projection conical and obtuse or apiculate, the lateral projections very much curved towards the poles and generally bidentate, lateral margins towards the poles serrate. Cell-wall smooth or delicately punctate.

Zygospore globose, furnished with stout, furcate spines.

Length 174–202 μ; breadth 136–180 μ; breadth of isthmus 21–23 μ; thickness without projections 34–39 μ, with projections 53–57 μ.

England.—Angle Tarn, Cumberland! Bowness, Westmoreland! (*Bissett*). Malham Tarn Bog, W.

Yorks! Pilmoor and Terrington, N. Yorks! Near Cockley Beck, Lancashire! Chobham and Thursley Commons, Surrey!

Scotland. — Ross, Aberdeen, Kincardine, Forfar, Perth!, Stirling, Dumbarton (*Roy & Bissett*). Sutherland! Balallan, Lewis, Outer Hebrides! Zygospore from Fyvie, Aberdeen (*Joshua*).

Ireland.—Lough Akibbon, Donegal! Glen Caragh and Cloonee Lough, Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Galicia in Austria. Norway. Sweden. Ceylon. Singapore. Java (var.). United States.

This species, which in its type form is so characteristic, is one of the most variable in the genus. The relative size of the basal projections, and the number and disposition of the surface-teeth are very variable, and it is sometimes difficult to obtain two individuals which agree in these respects.

M. Thomasiana has a greater affinity with *M. denticulata* than with *M. rotata*, and some authors have placed it as a form of that species. It is smaller than *M. denticulata*, the lobulation is more acute, and it differs in a striking manner in the projections present at the base of the semicells, as well as in the teeth within the bases of the lobes and lobules. It must be borne in mind, however, that these characters are not constant. The teeth within the lobules are generally reduced in number and somewhat irregular in their disposition, and it is not unusual for the median basal projection to be entirely absent. Such forms are figured in G. S. West, 'Variation Desm.' 1899, t. 9, figs. 6 and 7.

Individuals are frequently met with in which the basal projections are much reduced, and the surface-teeth are scarcely evident. These constitute an intermediate series of forms between *M. denticulata* and *M. Thomasiana*. Such a form is figured on Pl. LI, fig. 7.

Forma **major** West.

M. Thomasiana forma *major* West, Alg. W. Ireland, 1892, p. 134.

Cells about half as large again as the type.

Length 315 μ; breadth 285 μ; breadth of isthmus 38 μ.

Ireland.—Arderry Lough, Galway!

Large specimens (over 300 μ in length) were frequent in the above-mentioned lake. The largest form we have seen from the United States measured:—length 271 μ; breadth 230 μ; breadth of isthmus 28 μ.

15. **Micrasterias radiata** Hass.

(Plate LII, figs. 1-9.)

Micrasterias melitensis Ralfs in Ann. Mag. Nat. Hist. 1844, xiv, p. 260 t. 6, f. 2. [Not *M. melitensis* Menegh. 1840 = *Euastrum Crux-melitensis* Ehrenb. 1832 = *M. Crux-melitensis* (Ehrenb.) Hass. 1845.]

M. radiata Hass. Brit. Freshw. Hass. 1845, p. 386, t. 90, f. 2 [figure bad].

M. furcata Ralfs, Brit. Desm. 1848, p. 73, t. 9, f. 2 [Not *M. furcata* Ag. 1827]; Arch. in Pritch. Infus. 1861, p. 726; Nordst. Desm. Bras. 1870, p. 220, t. 2, f. 13; Lund. Desm. Suec. 1871, p. 14; Kirchn. Alg. Schles. 1878, p. 161; Wolle, Desm. U. S. 1884, p. 111, t. 35, f. 5, 6; Cooke, Brit. Desm. 1886, p. 55, t. 21, f. 1; Hansg. Prodr. Algenfl. Böhm. 1888, p. 208; West, Freshw. Alg. Maine, II, 1891, p. 354; Alg. W. Ireland, 1892, p. 133; Johnson, Species of Micrasterias, 1894, p. 58, t. 6, f. 7–14; West & G. S. West, Some N. Amer. Desm. 1896, p. 239; Nordst. Index Desm. 1896, p. 126; West & G. S. West, Some Desm. U.S. 1898, p. 295 (cum fig.); Alg. N. Ireland, 1902, p. 30; Scott. Freshw. Plankton, I, 1903, p. 526.

M. melitensis Menegh. var. *gracilior* Kütz. Spec. Alg. 1849, p. 170.

Didymidium (*Micrasterias*) *furcatum* C *furcatum* Reinsch, Algenfl. Frank. 1867, p. 144.

Micrasterias Crux-melitensis (Ehrenb.) Hass. b. *furcata* Rabenh. Flor. Europ. Algar. III, 1868, p. 190.

M. pseudofurcata Wolle in Bull. Torr. Bot. Club, 1881, p. 1, t. 6, f. 3; Desm. U. S. 1884, p. 111, t. 35, f. 4; Lagerh. Bidr. Amer. Desm.-fl. 1885, p. 231.

M. furcata Ralfs var. *decurta* Turn. New and Rare Desm. 1885, p. 936 t. 16, f. 10.

M. furcata Ralfs var. *simplex* Wolle in Bull. Torr. Bot. Club, 1885, p. 128, t. 51, f. 6, 7.

Helierella furcata Kuntze, Revis. gen. plant. 1891, p. 898.

H. pseudofurcata Kuntze, l. c. p. 899.

Micrasterias furcata Ralfs *a typica* Turn. Freshw. Alg. E. India, 1893 p. 93, t. 5, f. 5 *a*.

M. furcata β *gracillima* Turn. l. c. f. 5 *b*.

M. furcata γ *expansa* Turn. l. c. f. 5 *c*.

Cells of medium size, usually a little longer than broad (but sometimes broader than long), very deeply constricted, sinus widely open with an acute apex; semicells 5-lobed, incisions between the lobes wide and fairly deep; polar lobe with subparallel sides in the lower half, dilated upwards, with each angle produced into a long, narrow, diverging process with a deeply-furcate apex; lateral lobes commonly equal, but subject to great variation, normally divided into two long,

narrow, diverging lobules (similar to the processes of the polar lobe) with deeply-furcate apices; sometimes one or both lateral lobes are simple and undivided. Side view of semicell ovate-lanceolate, apex produced. Vertical view narrowly subrhomboid, with produced and acuminate poles. Cell-wall smooth or finely punctate.

Zygospore unknown.

Length 123–195 μ; breadth 113–186 μ; breadth of isthmus 17–30 μ; breadth of polar lobe (maximum) 65–92 μ; thickness 27–30 μ.

Wales.—Capel Curig, Carnarvonshire! (*Cooke & Wills*). Dolgelly, Merioneth (*Ralfs*).

Scotland. — Plankton of Loch nan Cuinne! (*J. Murray*), and of Loch Shin!, Sutherland. Rhiconich, Sutherland! Plankton of Loch Fadaghoda, Lewis, Outer Hebrides!

Ireland.—Near Lough Magrath, Donegal! Derryclare Lough, Glendalough, and small loughs between Clifden and Roundstone, Galway!

Geogr. Distribution.—France. Germany. Galicia in Austria. Sweden. N. India. Central Africa. United States. Brazil. Paraguay.

Ralfs, in 1844, described and figured what he imagined was the same species as *Micrasterias melitensis* Menegh. The latter was originally described as *Euastrum Crux-melitensis* by Ehrenberg in 1832, and is now known as *Micrasterias Crux-melitensis* (Ehrenb.) Hass.

The first person to recognize that Ralfs' plant was different from *M. Crux-melitensis* was Hassall, and in his 'British Freshwater Algæ' in 1845 he named it *M. radiata*. Hassall's description is fairly good, but his figure is wretched. He distinctly states, however, that his name *M. radiata* is given to the same plant as that described and figured by Ralfs in 1844 under the name of *M. melitensis*.

In 1848, in his 'British Desmids,' Ralfs placed *Micrasterias radiata* Hass. and his own *M. melitensis* as synonyms of "*Micrasterias furcata* Ag." Agardh's description of *M. furcata* (in 'Flora,' 1827, p. 643) is very brief, and reads thus: "Micrasterias furcata, radiis pluries furcatis obtusis." From such an imperfect description it is quite impossible to be sure of

the identity of any of the known species of *Micrasterias*, but, fortunately, some of Agardh's original specimens have been examined by Nordstedt, and a drawing of one of them by Turner. These have been shown beyond a doubt to be *M. rotata* (Grev.) Ralfs, and *M. denticulata* Bréb., two species which were not differentiated until many years after the publication of Agardh's *M. furcata*. Thus, Ralfs was greatly in error when he referred *M. radiata* Hass. to *M. furcata* Ag., and *M. radiata* Hass. remains as the first name given to the characteristic *Micrasterias* which has been generally referred to either as "*M. furcata* Ag." or "*M. furcata* Ralfs."

M. radiata Hass. is more variable in the subdivision of the lateral lobes than any other species of the genus. This was admirably shown by Johnson ('Bot. Gazette,' 1894, pp. 58–60, pl. vi, figs. 7–14), and after examining numerous American forms of this species, we thoroughly agree with him that *M. pseudofurcata* Wolle, *M. furcata* var. *decurta* Turn., and *M. furcata* var. *simplex* Wolle, are merely forms of *M. radiata* between which it is impossible to discriminate. It is not uncommon to find that one semicell represents typical *M. radiata* and the other semicell of the same plant represents *M. pseudofurcata*. This variation is of far commoner occurrence in the United States than in the British Islands, possibly because *M. radiata* is much more generally distributed in the United States than in this country. In Britain we have only met with this notable variation of the lateral lobes in the Scottish plankton, and it is possible that the variation is largely due to rapidity of cell-division.

Forms are occasionally met with in which the superior lateral lobules (or even the superior lateral lobes) are upwardly curved towards the processes of the polar lobe (Pl. LII, fig. 6). Similar forms have also been seen from America (*vide* W. & G. S. West, 'Some Desm. of the U.S.' 1898, p. 295, fig. xylogr. 2 *a*).

M. radiata should never be confused with *M. Crux-meli-tensis*, a species to which it only bears a superficial resemblance. The lobulation is deeper, and the lobules are much more elongate and bifurcate. It is also a larger species.

In some specimens the lobules are of great length, approaching a plant described by Wolle as *M. dichotoma*. We give a figure of one of these forms (Pl. LII, fig. 7).

The lateral lobules are sometimes entire and apiculate, and occasionally they are furcate in a plane at right angles to the principal plane of the cell (*vide* Pl. LII, figs. 8 and 9).

16. **Micrasterias Crux-melitensis** (Ehrenb.) Hass.
(Pl. LIII, figs. 1–3.)

Euastrum Crux-melitensis Ehrenb. Entwick. Lebends. d. Infus. 1832, p. 82; Infus. 1838, p. 161, t. 12, f. III; Kütz. Phycolog. germ. 1845, p. 134.

Cosmarium Crux-melitensis Corda in Alm. de Carlsbad, 1839, p. 243.

Micrasterias melitensis Menegh. Synops. Desm. 1840, p. 216; Kütz. spec. Alg. 1849, p. 170.

Micrasterias Crux-melitensis (Ehrenb.) Hass. Brit. Freshw. Alg. 1845, p. 386, t. 90, f. 7; Ralfs, Brit. Desm. 1848, p. 73, t. 9, f. 3; De Bary, Conj. 1858, p. 41; Arch. in Pritch. Infus. 1861, p. 726, t. 1, f. 22; Buln. in Hedwigia, 1862, p. 57, t. 10, f. 1 [forms]; Rabenh. Flor. Europ. Alg. III, 1868, p. 190; Delp. Desm. subalp. 1873, p. 87, t. 4, f. 7; Kirchn. Alg. Schles. 1878, p. 161; Turn. Alg. Strensall Common, 1883, f. 23; Wolle, Desm. U.S. 1884, p. 111, t. 35, f. 3; Cooke, Brit. Desm. 1886, p. 55, t. 21, f. 2; Hansg. Prodr. Algenfl. Böhm. 1888, p. 208, f. 118; Hauptfl. Zellm. u. Hüllgallerte Desm. 1888, p. 93, t. 3, f. 25, 26; De Toni, Syll. Alg. 1889, p. 1113; Benn. Freshw. Alg. Hamps. and Devon, 1890, p. 7, t. 1, f. 13 [figure very bad]; West, Alg. W. Ireland, 1892, p. 133; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 173; Nordst. Index Desm. 1896, p. 90; West & G. S. West, Alga-fl. Yorks. 1900, p. 67.

M. Crux-melitensis var. *superflua* Turn. Some New and Rare Desm. 1885, p. 936, t. 15, f. 11.

Helierella Crux-melitensis Kuntze, Revis. gen. plant. 1891, p. 897.

Cells of moderate size, a little longer than broad, very deeply constricted, sinus open with acute or linear apex; semicells 5-lobed, interlobular incisions widely open, those on each side of the polar lobe much deeper than those between the superior and inferior lateral lobes; polar lobe subquadrate in its lower half, upper half dilated, apex widely retuse, angles produced into short diverging processes with emarginate-bidentate apices; lateral lobes divided into two short, slightly diverging, elongate-quadrate lobules, emarginate-bidentate (sometimes tridentate or quadridentate with a median notch) at the apex. Vertical view subrhomboid-elliptical, with slightly produced poles. Cell-wall smooth or very delicately punctate.

Zygospore unknown.

Length 107–126 μ; breadth 98–118 μ; breadth of isthmus 16–19 μ; breadth of polar lobe (maximum) 35–43 μ.

England.—Ambleside (*Ralfs*) and Bowness!, Westmoreland. Strensall! (*Turner*) and Pilmoor!, N. Yorks.

Hampsfell, Lancashire! Cheshire (*Ralfs*). Norfolk (*Cooke*). Sussex (*Ralfs*). Hants (*Bennett*).

Wales.—Dolgelly, Merioneth (*Ralfs*).

Scotland.—Scotston Moor, Brimmond, near Old Meldrum, Slewdrum, Birsemore Loch, Tomachar, and Homehead in Cromar, Aberdeen; near Cammie in Strachan, Kincardine; Clova Tableland, Forfar; Durdie, Perth (*Roy & Bissett*).

Ireland.—Creggan Lough, Ballynahinch, and loughs near Recess, Galway! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Austria. Galicia. Hungary. Italy. Sweden. Denmark. Poland. N. and S. Russia. Japan. N. India. Ceylon. Burma. Celebes. Madagascar (var.). Central Africa. United States. Brazil.

The variation of this species is principally confined to the subdivisions of the lateral lobes. The two lobules of each lateral lobe are normally somewhat truncate and bidentate, but occasionally some or all of the lobules are tridentate or even further divided by a fairly deep notch into two bidenticulate parts. One of these forms is figured on Pl. LIII, fig. 3, and Turner described another under the name of "var. *superflua*."

M. Crux-melitensis is a rare species, easily distinguished from *M. radiata* by its smaller size, and the much shorter and stouter lobules, which are never deeply furcate.

Forma **punctulata** West.

M. Crux-melitensis forma *punctulata* West, Alg. Eng. Lake Distr. 1892, p. 722.

Cell-wall irregularly punctulate (or subgranulose), causing the outline of the cell to appear minutely papillate.

Length 122 μ; breadth 115 μ; breadth of isthmus, 21 μ.

England.—Near Bowness, Westmoreland!

17. **Micrasterias Americana** (Ehrenb.) Ralfs.

(Pl. LIII, figs. 4, 5; Pl. LIV, figs. 1–3.)

Euastrum Americanum Ehrenb. Verbreitung u. Einfluss des microscop. Lebens in Süd- u. Nord-amerika, Physik. Abh. Preuss. Akad. d. Wiss. zu Berlin, 1843, p. 413, t. 4, f. I 15.

Micrasterias Americana (Ehrenb.) Ralfs, Brit. Desm. 1848, p. xix; Arch. in Pritch. Infus. 1861, p. 726, t. 2, f. 44; Rabenh. Flor. Europ. Algar. III, 1868, p. 189; Kirchn. Alg. Schles. 1878, p. 161; Wills in Midland Naturalist, iv, 1881, t. 5, f. 4; Wolle, Desm. U.S. 1884, p. 112, t. 32, f. 2; Cooke, Brit. Desm. 1886, p. 56, t. 30, f. 1; Mask. Note Micr. Americana, 1888, p. 9; De Toni, Syll. Alg. 1889, p. 1134; West, Alg. N. Yorks. 1889, p. 291; Alg. N. Wales, 1890, p. 286; Alg. W. Ireland, 1892, p. 134; Alg. Eng. Lake Distr. 1892, p. 722; Roy & Biss. Scott. Desm. 1893, p. 173; Nordst. Index Desm. 1896, p. 42; West & G. S. West, Alg. S. England, 1897, p. 484; Alga-fl. Yorks. 1900, p. 67; Scott. Freshw. Plankton, I, 1903, p. 526.

M. morsa Ralfs, Brit. Desm. 1848, p. 74, t. 10, f. 1. [Ralfs in his 'Errata,' p. xix, states "for *M. morsa* read *M. Americana* (Ehr.)."]

Didymidium (*Micrasterias*) *morsum* Reinsch, Algenfl. Frank. 1867, p. 143.

Micrasterias Americana f. *genuina* Mask. Note Micr. Americana, 1888, t. 1, f. 1.

M. Americana var. *typica* Racib. Desm. Nowe, 1889, p. 106; Gutw. Flor. Glon. Okolic Lwowa, 1891, p. 74.

Helierella Americana Kuntze, Revis. gen. plant. 1891, p. 898.

Cells of medium size, about $1\frac{1}{6}$ times longer than broad, subhexagonal, very deeply constricted, sinus somewhat open, towards the apex acute; semicells 5-lobed (sometimes almost 3-lobed owing to shallow incision between the lateral lobes); polar lobe large, broad, and outstanding, cuneate from the base upwards (rarely subquadrate in the basal part), apical margin widely retuse, angles each produced into a thick divergent process with a truncate-denticulate apex, from near the base of each process a second accessory process arises, similar but smaller, and the two accessory processes are disposed asymmetrically one on each side of the polar lobe; incisions on each side of polar lobe widely open; lateral lobes rather small, incision between them open and not very deep, the two lobes of each side being together trapezoid in form, each lobe divided into two lobules by a wide and shallow notch, the two proximate lobules being smaller than the two distal lobules, lobules with three or four teeth at the extremity and dentate along their inner margins. Semicells with a few more or less scattered granules arranged on a small protuberance in the middle above the isthmus, with about four very large, acute granules within the apical margin of the polar lobe, and with a number of scattered smaller granules on the surface of both polar

and lateral lobes. Side view of semicell ovate-pyramidate, with a small granulate basal inflation, and showing the asymmetrical apical processes. Vertical view rhomboid-fusiform, with a small granulate protuberance at the middle on each side, poles produced and truncate-denticulate, polar lobe showing the asymmetrical disposition of the apical processes.

Zygospore unknown.

Length 125–160 μ; breadth 100–145 μ; breadth (maximum) of polar lobe 63–75 μ; breadth of isthmus 17–22·5 μ.

England.—Bowness and Deepdale, Westmoreland! Mickle Fell, N. Yorks! Askwith Moor, and Cocket Moss near Giggleswick, W. Yorks! Warwickshire (*Wills*). Near Chapel Wood, Surrey! Sussex (*Ralfs*).

Wales.—Capel Curig! (*Cooke & Wills*), Snowdon!, Carnarvonshire. Dolgelly, Merionethshire (*Ralfs*).

Scotland.—Scotston Moor, Powlair, Birsemore, Slewdrum, Morven, Lochnagar, and Corrie of Loch Ceanmhor, Aberdeen; Glen Dye and Clochnaben, Kincardine; Lundie Bog near Menmuir, Forfar (*Roy & Bissett*). Glen Shee and Glas Maol, Perth! Plankton of Loch Doon, Ayr! Loch Ness! (*J. Murray*), and plankton of Lochs Shiel and na Cloiche Sgoilt!, Inverness.

Ireland.—Dublin and Wicklow (*Archer*). Carrantuohill, Kerry.

Geogr. Distribution.—France. Germany. Galicia. Hungary. Norway. Sweden. Bornholm. Poland. Greenland. N. India. E. Africa. United States.

M. Americana is principally characterized by the form of its lateral lobes. It has a wide distribution in the British Islands, but is an uncommon species.

Var. **recta** Wolle. (Pl. LIV, fig. 4).

M. Americana var. *recta* Wolle in Bull. Torr. Bot. Club, 1876, p. 122; 1881, t. 6, f. 2; Desm. U.S. 1884, p. 112, t. 32, f. 2; West, Alg. N. Yorks. 1889, t. 291, f. 13, Alg. N. Wales, 1890, p. 286.

Extremities of lateral lobes and polar lobe rounded, not denticulate; apex of polar lobe almost straight

and slightly undulate, accessory processes reduced and rounded; incision between the two lateral lobes narrowly linear.

Length 117 μ; breadth 98 μ; breadth (max.) of polar lobe 55 μ; breadth of isthmus 19 μ.

England.—Mickle Fell, N. Yorks!

Wales.—Near Dolbadarn Castle, Carnarvonshire!

Geogr. Distribution.—United States.

Var. **Lewisiana** West. (Pl. LIV, figs. 5, 6.)

M. Americana var. *Lewisiana* West, Alg. N. Wales, 1890, p. 286, t. 5, f. 13; West & G. S. West, Some Desm. U.S. 1898, p. 296.

Smaller than the type; polar lobe shorter and stouter, lateral angles short and thick, with tricrenate apices, apical margin almost straight, very slightly retuse in the middle, accessory processes wanting, or represented by very small, rounded protuberances; lateral lobes with the margins crenate (not dentate). Cell-wall distinctly punctate.

Length 95–100 μ; breadth 72–85 μ; maximum breadth of polar lobe 48–54 μ; breadth of isthmus 16–17·5 μ.

Wales.—Llyn Padarn, Carnarvonshire!

Geogr. Distribution.—United States.

This characteristic variety can be recognized at once by the form of the polar lobe. The dimensions of the American specimens were: length 80–103 μ; breadth 70–84 μ; breadth of isthmus 23–26 μ.

Var. **Boldtii** Gutw. (Pl. LIII, fig. 6.)

M. Americana forma, Boldt, Desmid. Grönland, 1888, p. 5, t. 1, f. 1.
M. Americana var. *Boldtii* Gutw. Wahr. d. Priorität, 1890, p. 73; Flor. Glon. Okolic Lwowa, 1891, p. 74, t. 3, f. 27.

Polar lobe shorter than in the type, lateral angles produced into very short processes, apical margin very slightly concave, accessory processes much reduced, sometimes wanting on one or both semicells; lateral lobes more irregularly dentate.

Length 110–137 μ; breadth 96–111 μ; maximum

breadth of polar lobe 53–65 μ; breadth of isthmus 25–26 μ; thickness 48 μ.

England.—Mickle Fell, N. Yorks.

Geogr. Distribution.—Greenland. Galicia in Austria.

18. **Micrasterias Mahabuleshwarensis** Hobson.

Micrasterias Mahabuleshwarensis Hobson in Quart. Journ. Micr. Sci. 1863, p. 168 (with fig.), 169; Arch. in Quart. Journ. Micr. Sci. 1865, p. 255; Rabenh. Flor. Europ. Alg. III, 1868, p. 196; Lund. Desm. Suec. 1871, p. 15, t. 1, f. 6; Wolle, Desm. U.S. 1884, p. 112, t. 37, f. 10; Hansg. Prodr. Algenfl. Böhm. 1888, p. 253; Nordst. Freshw. Alg. N. Zeal. 1888, p. 31; De Toni, Syll. Alg. 1889, p. 1122; Turn. Freshw. Alg. E. India, 1893, p. 95; Nordst. Index Desmid. 1896, p. 163; West & G. S. West, Freshw. Chlorophy. Koh Chang, 1901, p. 85.

M. Americana forma *Mahabuleshwarensis* Mask. Note Micr. Americana, 1888, p. 9, t. 1, f. 8.

Helierella Mahabuleshwarensis Kuntze, Revis. gen. plant. 1891, p. 899.

Cells moderately large, about $1\frac{1}{6}$ times longer than broad, very deeply constricted, sinus open with an acuminate apex; semicells 3-lobed, incision between lateral lobes and polar lobe very wide; polar lobe large and outstanding, lower half subquadrate, upper half dilated, with the angles produced into diverging (sometimes almost horizontal), denticulate processes of considerable (and variable) length, with a pair of accessory denticulate processes disposed asymmetrically, one at the front and one at the back near the base of each lateral process, apical margin straight, slightly convex, or slightly concave, generally with several large granules (or short, acute spines) within the margin; lateral lobes deeply divided into two lobules by a wide acute-angled incision, each lobule in the form of an attenuated denticulate process; apices of all the processes tri- or quadridenticulate; semicells in the middle above the isthmus furnished with a small granulate or denticulate protuberance, with a row of denticulations within the lateral lobes (sometimes with several scattered series) and within the lateral margins of the polar lobe, these series generally extending to the basal protuberance. Side view of semicell narrowly oblong-ovate, with a small basal inflation on each side, apex showing the asymmetrical disposition of the four pro-

cesses. Vertical view rhomboid-fusiform, poles attenuated and tridenticulate, at the middle on each side with a small granulate or denticulate protuberance, polar lobe showing very clearly the disposition of the four processes.

Zygospore unknown.

Length 151–220 μ; breadth 135–190 μ; maximum breadth of polar lobe 75–100 μ; breadth of isthmus 19–22 μ; thickness 40–47 μ.

Geogr. Distribution. — Austria. Sweden. India. Burmah. Siam. Java. New Zealand (var.). Australia. E. Africa. Madagascar (var.). United States. British Guiana.

This species is principally tropical and subtropical in its distribution, and the typical form has not so far been met with in the British Islands. It is subject to great variation in the length of the processes, both of the polar and lateral lobes, in the amount of their divergence, and in the details of the surface-markings. The lateral lobules are often subdivided, and the subdivision is exceedingly variable. This has resulted in the naming of numerous varieties.

Var. **Wallichii** (Grun.) *nob.* (Pl. LIV, figs. 7, 8; Pl. LV, figs. 1–3.)

M. Wallichii Grun. Diat. u. Desm. Ins. Bank. 1865, p. 14, t. 2, f. 21; Arch. in Quart. Journ. Micr. Sci. 1865, p. 260, 261; Rabenh. Flor. Europ. Alg. III, 1868, p. 196; Lund. Desm. Suec. 1871, p. 15; Kirchn. Alg. Schles. 1878, p. 161; De Toni, Syll. Alg. 1889, p. 1123; Turn. Freshw. Alg. of E. India, 1893, p. 95; Nordst. Index Desm. 1896, p. 271.

M. Hermanniana Reinsch, Spec. Gen. Alg. 1867, p. 120, t. 21 B, f. 1–4.

Didymidium (*Micrasterias*) *Hermanniana* Reinsch, Algenfl. Frank. 1867, p. 141, t. 8, f. 1.

M. ampullacea Mask. N. Zeal. Desm. 1881, p. 304, t. 11, f. 6–8 [*M. Mahabuleshwarensis* β *ampullacea* Nordst 1888].

M. Americana forma *Wallichii* Mask. Note Micr. Americana, 1888, p. 9, t. 1, f. 9.

M. Mahabuleshwarensis Hobson A. *genuina* a. *indica* Nordst. Freshw. Alg. N. Zeal. 1888, p. 31 [also various other forms].

Helierella Wallichii Kuntze, Revis. gen. plant. 1891, p. 899.

Micrasterias Wallichii f. *typica* Turn. Freshw. Alg. E. India, 1893, p. 95, t. 6, f. 1.

M. Wallichii f. *major* Turn. l. c.

M. Wallichii var. *Hermanniana* (Reinsch) Turn. l. c. [various forms, including *M. ampullacea* Mask.].

This variety is distinguished by the subdivision of the superior lateral lobules, each of which is divided by

a deep and wide incision. There are thus three denticulate processes to each lateral lobe, the lowermost one being somewhat larger than the two upper ones.

Dimensions of British specimens: — length 181–223 μ; breadth 153–188 μ; maximum breadth of polar lobe 88–115 μ; breadth of isthmus 30–33 μ; thickness 48·5 μ.

Dimensions given by various authors:—Length 132–224 μ; breadth 115–208 μ.

Scotland.—In the plankton of Loch nan Eun and Loch Bhaic!, Perthshire; Lochs Ruar! and nan Cuinne, Sutherland; Lochs Burraland and Littlester, Shetlands (*J. Murray*).

Geogr. Distribution. — Germany. Sweden. India. Banka Is. Samoa. Fiji (var.). New Zealand (var.).

After a careful comparison of specimens of *M. Mahabuleshwarensis* from divers parts of the world, it appears to us that there is one variety, which although in itself very variable, yet retains certain distinctive features. This variety is distinguished by the subdivision of the superior lateral lobules, so that there are three lateral processes instead of the two which are found in the more typical forms. The relative length, thickness, and divergence of these processes is exceedingly variable, but the presence of the *three processes in place of two* is a character the use of which is quite justifiable as a varietal distinction. It was originally described as *Micrasterias Wallichii* by Grunow, but a comparison of its different forms with those in which the superior lateral lobules are undivided shows conclusively that it can only be considered as a variety of *M. Mahabuleshwarensis*.

In the British Islands, *M. Mahabuleshwarensis* var. *Wallichii* has only been found in the plankton of certain Scottish lochs, and the credit of this discovery rests entirely with Mr. James Murray of the Scottish Lake Survey. In some cases the specimens were subject to great variation, and this was especially the case in Loch Bhaic, Perthshire. The variation was principally in the duplication of the lateral processes. In some individuals the upper process of the superior lateral lobules was duplicated (*vide* Pl. LV, fig. 2), and in others the lower process was similarly doubled. A few individuals showed a duplication of the large processes of the polar lobe (*vide* Pl. LV, fig. 3). This curious abnormal state, with six

processes on the polar lobe, was first mentioned by Lundell ('Desm. Suec.' 1871, p. 15). The figure we give of this form also shows the lobulation of typical *M. Mahabuleshwarensis* on one side of the semicell and that of the var. *Wallichii* on the other. This in itself is conclusive proof that the Desmid originally described as *Micrasterias Wallichii* is only a variety (in some localities well established) of *M. Mahabuleshwarensis*.

Species to be inquired into.

Micrasterias cornuta Benn. (Pl. LI, fig. 1.)

Micrasterias cornuta Benn. Freshw. Alg. Eng. Lake Distr. 1886, p. 7, t. 1, f. 6; Cooke, Brit. Desm. 1886, p. 57, t. 23 [after Bennett]; De Toni, Syll. Alg. 1889, p. 1156.
Helierella Bennettii Kuntze, Revis. gen. plant. 1891, p. 898.

Cells large, deeply constricted, sinus narrowly linear; semicells with a large projecting polar lobe, the angles of which are bluntly rounded and the apex deeply concave; lateral lobes (according to Bennett's figure) three on each side, separated by two narrow and not very deep primary incisions, each lobe divided by a narrow secondary incision into two lobules, each lobule rounded-truncate with a median emargination or incision.

Length 355 μ; breadth 305 μ.

England.—Stream between Codale and Stickle Tarns, Westmoreland, at an elevation of about 1,800 ft. (*Bennett*).

We do not think Bennett's figure of this *Micrasterias*, of which we give a copy, is a correct one. No known species of the genus possesses lateral incisions of the nature he has figured. Had the lower of the two deepest lateral incisions been made much deeper, this would have given a lobulation somewhat comparable with that of *M. rotata*. Taking into consideration the *great inaccuracy* of most of Bennett's published figures, we should imagine that the Desmid he had under observation when he made his drawing was a large, and possibly an abnormal form of *M. rotata*.

Genus 15. **Cosmarium** Corda, 1834.

Corda in Alm. de Carlsbad, 1834.
Ralfs in Ann. Mag. Nat. Hist. 1844, p. 391.
Hass. Brit. Freshw. Alg. 1845, p. 361.
Ralfs, Brit. Desm. 1848, p. 91.
De Bary, Conj. 1858, p. 72.
Arch. in Pritch. Infus. 1861, pp. 720, 731.
Rabenh. Flor. Europ. Alg. 1868, III, p. 157.
Delp. Desm. subalp. 1873, p. 38.
Kirchn. Alg. Schles. 1878, p. 145.
Wolle, Desm. U.S. 1884, p. 57.
Cooke, Brit. Desm. 1886, p. 79.
Hansg. Prodr. Algenfl. Böhm. 1888, p. 192.
De Toni, Syll. Alg. 1889, p. 931.
Wille in Naturl. Pflanzenfam. 1899, p. 10.
G. S. West, Treatise Brit. Freshw. Alg. 1904, p. 166.

Cells very variable in size, usually a little longer than broad (sometimes $1\frac{1}{2}$ times or rarely about twice as long as broad), generally somewhat compressed, symmetrical in three planes at right angles to each other; constricted in the middle, often deeply, but sometimes very slightly; semicells very variable in outline, elliptical, subcircular, semicircular, subquadrate, or truncate-pyramidate, apex rounded, truncate or subtruncate, without an apical incision, centre of the semicell sometimes protuberant; vertical view elliptic, subelliptic, or oblong (rarely circular), often with a protuberance (sometimes more than one) at the middle on each side. Chloroplasts usually axile, one in each semicell, with four curved longitudinal plates and a large central pyrenoid, or with two large pyrenoids transversely disposed; in a few species parietal, 4–8 in each semicell, with one or more pyrenoids in each chloroplast. Cell-wall smooth, punctate, scrobiculate, granulate, verrucose, or papillate, the various markings usually being arranged in a definite pattern.

Zygospores very variable, globose, ellipsoid, or quadrate in form, smooth, scrobiculate, papillate, or furnished with furcate, or more rarely simple, spines.

The genus *Cosmarium* is the largest of the genera of Desmids, and includes several hundred species. One of the

distinguishing features of a *Cosmarium* is the *entire* outline of the cells, which are likewise destitute of spines. There is no lobulation of the margin of the semicells at all comparable to that which forms such a feature of most species of *Euastrum*, and there is a complete absence of an apical notch.

Among the large number of species at present included in the genus there are several transitional forms which could almost equally well be referred to other genera. A few are closely related to certain species of *Euastrum*, and others can scarcely be distinguished from some of the constricted species of *Penium*. Spines are as a rule absent from species of *Cosmarium*, but a few of the smaller species closely approach the genus *Xanthidium* in the possession of minute, marginal or submarginal spines.

Kuntze ('Revis. gen. plant.' 1891, p. 922) revived the name *Ursinella* Turpin ('Aperçu organograph.' 1828, p. 316) which he substituted for *Cosmarium* Corda (1834). Turpin's description is exceedingly bad and scarcely applies to the genus *Cosmarium* as now understood. For this reason the name "*Ursinella*" has been universally rejected. *Vide* Nordst. in 'Hedwigia,' 1893, p. 152.

Several attempts have been made to subdivide the genus by the character and disposition of the chloroplasts. Lundell (1879) instituted the subgenus *Pleurotæniopsis* to include those species of *Cosmarium* with parietal chloroplasts, and in 1887 Lagerheim placed it as a genus. Gay (1884) also described the genus *Cosmaridium* to include *Cosmarium Cucumis*, a species characterized by its parietal chloroplasts. With regard to the chloroplasts in the genus *Cosmarium*, it must be borne in mind that the axile condition is unquestionably the primitive one, and that the parietal condition has been independently acquired by a few scattered species of the genus. The removal of these species from all their nearest relatives and their inclusion in a separate genus is very inexpedient, as it results in the association of species having no affinity with each other and which are not in any way closely related. Moreover, as transitional conditions are sometimes observed between truly axile and truly parietal chloroplasts (*vide* Pl. LX, fig. 4), the disposition of the chloroplasts cannot well be taken as a basis for the primary subdivision of the genus.

Many of the slightly constricted species have been placed by various authors in the genus *Dysphinctium* Näg. (1849). This genus, with which must be identified *Calocylindrus* (Näg.) Kirchn. (1878), has been differentiated from *Cosmarium*

by the subcylindrical cells (in vertical view circular), by the slight median constriction, and by the absence of a basal inflation of the semicells. Circular vertical views are, however, met with along with every possible grade of constriction (cfr. *C. annulatum*, *C. subturgidum*, *C. moniliforme*, *C. globulatum*, and *C. Welwitschii*), and species are known, which, although but faintly constricted, yet possess an elliptical vertical view (cfr. *C. anceps*, *C. Oocystidum*). It would be unwise to fix an arbitrary depth of constriction, and to include all those species more constricted than the demarcation limit in the genus *Cosmarium* and those less constricted in the genus *Dysphinctium*. Yet, there is no other way of clearly defining Nägeli's genus. Those authors who most strongly uphold the retention of *Dysphinctium* as a genus are not agreed on the species which should be included in it. One also finds *Cosmarium speciosum* referred to *Dysphinctium*, and its nearest relative, *C. subspeciosum*, retained in the genus *Cosmarium*. Considering all these facts, we have thought it best not to adopt a genus which is based upon indefinite characters and the limitations of which could not be clearly defined. Moreover, opinion would always remain divided with regard to the inclusion of many species in *Dysphinctium* or their retention in *Cosmarium*.

The arrangement of the numerous species of *Cosmarium* in the present volume is a purely artificial one, but one which we think will best meet the requirements of the student. We have divided the genus into two large groups, a section with smooth cell-walls and a section with rough cell-walls. This arrangement will be of great assistance to the student in running down a species, and at the same time it allows of the grouping together of species with close affinities. Of course, the terms "smooth" and "rough" are only relative, and there are a few species which might equally well be placed in either section. The primary subdivisions of the sections are in all cases based upon the external form of the semicells as seen in front view.

Division I. Cell-wall smooth, punctulate, or scrobiculate, outline never granulate, margins sometimes undulate or crenate.

Division II. Cell-wall granulate, verrucose, or papillate.

As the genus is so very large we have divided the synopsis of species into two parts, the first part being placed before the descriptions of the smooth species and the second part immediately before the descriptions of the rough species.

Division I. Cell-wall smooth, punctulate or scrobiculate, outline never granulate, margins sometimes undulate or crenate.

Section A. Semicells semicircular, semi-elliptical, or subsemicircular in outline.

* Semicells semicircular or subsemicircular in outline; cells about as long as broad or a little longer than broad rarely $1\frac{1}{3}$ times longer than broad.

† Margin of semicells entire.

‡ Semicells with a blunt tooth or submamillate thickening at the basal angles.

1. *C. obsoletum.*
2. *C. Smolandicum.*

‡‡ Semicells without any mamillate thickening at the basal angles.

§ With no prominent scrobiculations in the centre of the semicells.

3. *C. taxichondriforme.*
4. *C. circulare.*
5. *C. Lundellii.*
6. *C. pachydermum.*
7. *C. Ralfsii.*

§§ With several prominent scrobiculations in the centre of the semicells.

8. *C. perforatum.*
9. *C. ocellatum.*

†† Margin of semicells undulate.

10. *C. cyclicum.*
11. *C. fontigenum.*
12. *C. undulatum.*

** Semicells semi-elliptical in outline; cells $1\frac{1}{2}$—2 times longer than broad.

† Margin of semicells undulate.

13. *C. subundulatum.*

†† Margin of semicells entire.

‡ Constriction moderately deep.

14. *C. Cucumis.*
15. *C. subcucumis.*

‡‡ Constriction slight.

§ Sinus linear. 16. *C. microsphinctum.*

§§ Sinus open. 17. *C. morsum.*

Section B. Semicells transversely elliptical, oblong-elliptical, or reniform in outline.

* Semicells elliptic-reniform; sinus closed.

† Isthmus narrow; vertical view with a protuberance on each side.

§ Apex of semicell entire.

18. *C. Phaseolus.*
19. *C. tumidum.*

§§ Apex of semicell with a slight notch.
20. *C. Trafalgaricum.*
†† Isthmus broader; vertical view elliptic.
21. *C. melanosporum.*
** Semicells elliptical or elliptic-oblong in outline; sinus open.
22. *C. aspherosporum.*
23. *C. inconspicuum.*
24. *C. bioculatum.*
25. *C. tenue.*
26. *C. tinctum.*
27. *C. flavum.*
28. *C. contractum.*
29. *C. subcontractum.*
30. *C. subaversum.*
** Semicells narrowly elliptical or elliptic-oblong, depressed.
† Cells with a granule on each side of the sinus.
31. *C. tetrachondrum.*
†† Cells destitute of granules.
32. *C. depressum.*
33. *C. subquadrans.*

Section C. Semicells distinctly pyramidate or subpyramidate in outline, usually truncate.
* Margin of semicells entire, not crenate or undulate.
† Semicells pyramidate, lateral margins retuse or subretuse, very rarely straight.
‡‡ Apex of semicells truncate or subtruncate.
§ Basal angles broadly rounded.
34. *C. succisum.*
35. *C. subretusiforme.*
36. *C. retusiforme.*
37. *C. Hammeri.*
38. *C. Nymannianum.*
§§ Basal angles rectangular.
39. *C. trilobulatum.*
40. *C. granatum.*
41. *C. Pokornyanum.*
‡‡ Apex of semicells very convex.
42. *C. pseudatlanthoideum.*
†† Semicells pyramidate, lateral margins convex, rarely straight.
‡ Cells never more than $1\frac{1}{4}$ times longer than broad.
§ Semicells pyramidate-semicircular.
43. *C. subtumidum.*
§§ Semicells pyramidate-trapeziform.
44. *C. galeritum.*
45. *C. pseudonitidulum.*
46. *C. nitidulum.*

‡‡ Cells $1\frac{1}{3}$–$1\frac{3}{4}$ times longer than broad.

47. *C. canaliculatum.*
48. *C. pyramidatum.*
49. *C. pseudopyramidatum.*
50. *C. variolatum.*

** Margin of semicells undulate or crenate.

† Semicells constricted and crenate just below the apices.

51. *C. Holmiense.*
52. *C. cymatopleurum.*

†† Semicells with the lateral margins undulate or crenate.

‡ Apex of semicells without undulations.

53. *C. obtusatum.*
54. *C. venustum.*
55. *C. Garrolense.*
56. *C. Reinschii.*

‡‡ Apex of semicells often slightly undulate.

57. *C. Nägelianum.*
58. *C. notabile.*
59. *C. tetragonum.*

Section D. Semicells circular or subcircular (rarely almost semicircular) in outline.

* Constriction fairly deep.

60. *C. moniliforme.*

** Constriction slight.

† Margin of semicells entire.

‡ Cells large or of medium size (47–102 μ in length).

61. *C. alpestre.*
62. *C. connatum.*
63. *C. pseudoconnatum.*

‡‡ Cells small (15–34 μ in length).

64. *C. globosum.*
65. *C. subarctoum.*
66. *C. pseudarctoum.*

†† Margin of semicells undulate.

67. *C. pericymatium.*

Section E. Semicells more or less rectangular or subrectangular (rarely subpyramidal).

* Margin of semicells crenate or undulate.

† Cells minute, sinus widely open.

68. *C. Novæ Semliæ.*
69. *C. Regnesi.*
70. *C. cymatonotophorum.*

†† Cells larger, sinus linear.

71. *C. rectangulum.*

** Margin of semicells entire.

† Constriction very slight.

72. *C. arctoum.*

†† Constriction moderately deep or deep.
‡ Lateral margins of semicells concave (rarely straight).
§ Cells about twice as long as broad.
73. *C. sinuosum.*
74. *C. tatricum.*
75. *C. anceps.*
§§ Cells about as long as broad, or a little longer.
a. Vertical view obliquely elliptical.
76. *C. obliquum.*
β. Vertical view elliptical.
77. *C. Norimbergense.*
78. *C. repandum.*
‡‡ Lateral margins of semicells straight or convex.
§ Superior angles of semicells much cut off.
79. *C. rectangulare.*
80. *C. subquadratum.*
§§ Superior angles of semicells rounded.
a. Cells large.
81. *C. quadratum.*
82. *C. plicatum.*
83. *C. Debaryi.*
β. Cells small.
84. *C. exiguum.*
85. *C. pseudexiguum.*
§§§ Superior angles of semicells not rounded.
86. *C. minimum.*
87. *C. pusillum.*
88. *C. geometricum.*
§§§§ Superior angles of semicells produced and submamillate.
89. *C. helcangulare.*
‡‡‡ Lateral margins of semicells upwardly diverging.
§ Vertical view elliptic.
90. *C. coarctatum.*
§§ Vertical view with a prominent protuberance on each side.
91. *C. protuberans.*

Section F. Semicells generally elliptic-hexagonal, subhexagonal, or polygonal in outline.
* Semicells distinctly elliptic-hexagonal.
† Sinus a shallow notch.
92. *C. Sphagnicolum.*
†† Sinus deep and widely open.
93. *C. truncatellum.*
94. *C. subcapitulum.*
††† Sinus linear.
‡ Vertical view with a distinct central protuberance.

§ Lateral angles acute or rounded.

95. *C. pygmæum.*
96. *C. polygonum.*
97. *C. pseudobiremum.*
98. *C. bireme.*
99. *C. adoxum.*
100. *C. Sinostegos.*

§§ Lateral angles emarginate.

101. *C. abruptum.*

‡‡ Vertical view with no distinct central protuberance.

102. *C. sexangulare.*
103. *C. pseudoprotuberans.*
104. *C. abbreviatum.*

** Semicells subhexagonal or polygonal.

† Angles of semicells produced.

105. *C. impressulum.*
106. *C. umbilicatum.*
107. *C. perpusillum.*
108. *C. Regnellii.*
109. *C. Meneghinii.*

†† Angles of semicells not produced.

110. *C. angulosum.*
111. *C. difficile.*
112. *C. Clepsydra.*

*** Semicells rounded-polygonal, sometimes almost subcircular.

113. *C. læve.*

Section G. Semicells obversely semicircular in outline, with the lateral angles distinctly produced.

114. *C. monochondrum.*

Section H. Cells subcylindrical or fusiform-cylindrical, with a very slight constriction.

* Cells subcylindrical.

† Lateral margins subparallel.

115. *C. Thwaitesii.*
116. *C. Cucurbita.*
117. *C. Palangula.*
118. *C. Subpalangula.*
119. *C. parvulum.*
120. *C. goniodes.*

†† Lateral margins not parallel, generally convex.

121. *C. viride.*
122. *C. oblongum.*
123. *C. Hibernicum.*
124. *C. turgidum.*
125. *C. subturgidum.*

** Cells fusiform-cylindrical.

126. *C. attenuatum.*

1. **Cosmarium obsoletum** (Hantzsch) Reinsch.

Pl. LVI, figs. 1–3.

Arthrodesmus obsoletus Hantzsch in Rabenh. Alg. 1862, no. 1407; Grun. Diat. u. Desm. Ins. Bank. 1865, p. 15, t. 2, f. 28.
Cosmarium obsoletum (Hantzsch) Reinsch, Spec. Gen. Alg. 1867, p. 142, t. 22, D. I, f. 1–4; Lund. Desm. Suec. 1871, p. 38; Nordst. Alg. et Char. I, 1880, p. 7, t. 1, f. 9; Wille, Sydamerik. Algfl. 1884, p. 16, t. 1, f. 33; De Toni, Syll. Alg. 1889, p. 974; West, Alg. W. Ireland, 1892, p. 144; Alg. Eng. Lake Distr. 1892, p. 724; Lütkemüll. Desm. Attersees, 1893, p. 556; Nordst. Index Desm. 1896, p. 186; West & G. S. West, Desm. Singapore, 1897, p. 164; Freshw. Chlorophy. Koh Chang, 1901, p. 87; Freshw. Alg. Ceylon, 1902, p. 164.
Didymidium (*Cosmarium*) *obsoletum* Reinsch. Algenfl. Frank. 1867, p. 110, t. 9, f. 5.
Ursinella obsoleta Kuntze, Revis. gen. plant. 1891, p. 925.
Cosmarium palustre Turn. Freshw. Alg. E. India, 1893, p. 60, t. 8, f. 65, t. 9, f. 29.
C. palustre var. *ovale* Turn, l. c. t. 9, f. 1.

Cells of medium size, transversely elliptic, a little broader than long, deeply constricted, sinus narrowly linear with a dilated apex; semicells semi-elliptic (depressed-semicircular), basal angles submamillate and slightly thickened, apex generally slightly flattened. Side view of semicell depressed-globose. Vertical view elliptic, with obtusely conical poles, ratio of axes 1 : 2·1. Cell-wall punctulate (or finely scrobiculate), sometimes slightly thickened in the centre of the semicells. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 34–46 μ; breadth 42–54 μ; breadth of isthmus 15·5–20 μ; thickness 20–24 μ.

England.—Bowness, Westmoreland!

Wales.—Yr Orsedd, Carnarvonshire!

Ireland.—Clogerheen, Kerry!

Geogr. Distribution.—Germany. Austria and Galicia. Sweden. N. Russia. Poland (var.). Central China. Japan. India. Ceylon. Siam. Singapore. Java. Egypt. New Zealand (var.). Australia. United States. Brazil.

This species is much more abundant in tropical and subtropical countries than in temperate climates, and it exhibits

a considerable range of variation. There is a thickening of the cell-wall at the basal angles of the semicells which commonly gives them a submamillate appearance.

Some of the tropical forms attain a large size :—length 57–64 μ; breadth 67–75 μ; breadth of isthmus 30–35 μ; thickness 36 μ. In these specimens the thickening of the basal angles is generally prominent, and passing through it is a large conical pore, the wider end of which is towards the interior of the cell-wall. We give a figure of one of these specimens from Singapore to show this character (Pl. LVI, fig. 4). Sometimes the mamillate thickening becomes quite hyaline with the exception of the conical pore, which then stands out very prominently, and has the appearance of a short spine attached to the basal angle. Turner figured this pore as a spine at the angle, and he put forward the name "*Cosmarium palustre*" for typical specimens of the large form of *C. obsoletum* which is so abundant in tropical Asia. It is in old individuals in which the cell-wall becomes of a yellow or yellow-brown colour that this "spinate" appearance is most marked. Sometimes the actual thickening of the basal angle has the form of a bluntly-conical mucro. The large tropical forms have recently been named "var. *Sitvense*" by Gutwinski ('Alg. Ins. Java,' 1902, p. 594, t. 38, f. 39), and so far as is known they are characteristic of the Indo-Malay region.

The British specimens are usually of small size and they show no trace of the pore which is present in the basal angles of the large tropical forms. The cell-wall of the smaller forms is finely punctate, but that of the larger forms is somewhat sparsely and finely scrobiculate.

2. **Cosmarium Smolandicum** Lund.

(Pl. LVI, fig. 5.)

Cosmarium Smolandicum Lund. Desm. Suec. 1871, p. 39, t. 2, f. 17; Wolle, Desm. U.S. 1884, p. 66, t. 16, f. 35, 36; De Toni, Syll. Alg. 1889, p. 984; Nordst. Index Desm. 1896, p. 235.
Ursinella Smolandica Kuntze, Revis. gen. plant. 1891, p. 925.

Cells of medium size, subcircular, a little longer than broad, very deeply constricted, sinus somewhat narrow and linear; semicells subsemicircular, apices convex but subtruncate in the middle, basal angles obtuse and furnished with a prominent papilla. Side

view of semicell circular. Vertical view elliptic, ratio of axes 1 : 1·71. Cell-wall punctate. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 54 μ; breadth 48 μ; breadth of isthmus 12 μ; thickness 28 μ.

Geogr. Distribution.—Sweden. United States.

The typical form of this species is not known to occur in the British Islands.

Var. **angustatum** *nob.* (Pl. LVI, figs. 6, 7.)

C. obsoletum (Hantzsch) Reinsch var. *angustatum* West, Alg. W. Ireland, 1892, p. 144, t. 24, f. 22.
C. obsoletum var. *angustatum* West forma *galiciensis* Gutw. Nonn. Alg. Nov. 1896, p. 49, t. 7, f. 46.

A variety with the sinus closed and linear, with the basal angles of the semicells rectangular and the lower part of the sides straight and parallel, and with the apex in the middle subtruncate.

Length 42·5–43·5 μ; breadth 34–37 μ; breadth of isthmus 11–14 μ.

Ireland.—Carrantuohill, Kerry!

Geogr. Distribution.—Galicia in Austria.

The Desmid described as *Cosmarium obsoletum* var. *angustatum* is much better referred to *C. Smolandicum* Lund. We have examined further specimens from Carrantuohill and find that the figure given in the 'Alg. W. Ireland,' tab. 24, fig. 22, is not a good one. The basal angles of the semicells are rectangular, and the mucro at each angle, although less prominent than in the type, projects laterally. The upper angles are also more rounded and the apex is more distinctly truncate. Thus, the specimen found by Gutwinski in Austria, which he named '*C. obsoletum* var. *angustatum* forma *galiciensis*,' and about which he remarks: "a forma irlandica differt angulis basalibus alias protractis, angulis superioribus magis rotundatis vel oblique truncatis," must also be referred to *C. Smolandicum* var. *angustatum*. Gutwinski's measurements of his Austrian specimens (length 40–43 μ; breadth 30·4–35 μ; breadth of isthmus 11–13 μ) agree almost exactly with the dimensions of the Irish forms.

3. **Cosmarium taxichondriforme** Eichl. & Gutw.

(Pl. LVI, figs. 8–10.)

Cosmarium taxichondriforme Eichl. & Gutw. Nonn. Spec. Alg. Nov. 1894, p. 169, t. 4, f. 23; Nordst. Index Desm. 1896, p. 250.

Cells rather small, as long as broad, circular-hexagonal, deeply constricted, sinus narrow and slightly open; semicells pyramidate-semicircular, basal angles very faintly produced and slightly thickened, generally turned downwards. Side view of semicell subcircular, with flattened apices. Vertical view elliptic with produced poles, ratio of axes 1 : 2. Cell-wall finely punctate. Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 31–41·5 μ; breadth 31–47 μ; breadth of isthmus 10–15 μ; thickness 17–22 μ.

England.—Bowness, Westmoreland!

Geogr. Distribution.—Galicia in Austria.

In outward appearance this species bears considerable resemblance to *Cosmarium taxichondrum* Lund., but is easily distinguished by the entire absence of surface granules and by the presence of only one pyrenoid in the axile chloroplasts.

It still more closely resembles a tropical species, *C. nudum* (Turn.) Gutw. (= *C. taxichondrum* var. *nudum* Turn.), from which it is distinguished by the single pyrenoid in each semicell and by the attenuation of the poles of the vertical view. It should also be compared with *C. crassangulatum* Borge ('Süssw. Chlor. Archang.' 1894, p. 25, t. 2, f. 23).

We have only observed this species from some small water-lily pools near Bowness in the English Lake District.

4. **Cosmarium circulare** Reinsch.

(Pl. LVI, figs. 11, 13, 14.)

Cosmarium circulare Reinsch, Spec. Gen. Alg. 1867, p. 113, t. 22, C. I, f. 1–4; Lund. Desm. Suec. 1871, p. 41; Wolle, Freshw. Alg. U.S. 1887, p. 28, t. 57, f. 37; Hansg. Prodr. Algenfl. Böhm. 1888, p. 249; De Toni, Syll. Alg. 1889, p. 975; West, Alg. N. Yorks. 1889, p. 292; Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 144; Nordst. Index Desm. 1896, p. 73.

Didymidium (*Cosmarium*) *circulare* Reinsch, Algenfl. Frank. 1867, p. 108, t. 10, f. 2.

Ursinella circularis Kuntze, Revis. gen. plant. 1891, p. 924.

Cells large, circular, about as long as broad, deeply constricted, sinus very narrow and linear, dilated at the extremity; semicells semicircular with rounded basal angles. Side view of semicell rounded-ovate or subcircular. Vertical view narrowly elliptic, ratio of axes 1 : 2·6. Cell-wall punctulate. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 54–95 μ; breadth 54–90 μ; breadth of isthmus 22–28 μ; thickness 25–38 μ.

England.—Mickle Fell, N. Yorks!

Wales.—Snowdon, Carnarvonshire!

Scotland.—Loch Ruthven, Inverness; near Loch Mharc, in Athole, Perth (*Roy & Bissett*).

Ireland.—Creggan Lough, Galway!

Geogr. Distribution.—Germany. Galicia in Austria. Hungary (var.). Sweden. S. Russia. India. E. Africa. United States. Brazil.

C. circulare Reinsch differs from *C. Ralfsii* Bréb. in the outward form of its cells and in its axile chloroplasts. The semicells of *C. circulare* are semicircular in outline and never exhibit the pyramidate character which is so conspicuous in *C. Ralfsii*.

C. circulare is distinguished from *C. Lundellii* Delp. by its semicircular semicells and its elliptical vertical view. The vertical view of *C. Lundellii* is drawn out at the poles and is sometimes almost rhomboid-elliptic, whereas that of *C. circulare* is narrowly elliptic. There is also a thickening of the cell-wall in the centre of the semicells of *C. Lundellii* which is never present in *C. circulare*.

Forma **minor** *nob.* (Pl. LVI, fig. 12.)

Cosmarium circulare Racib. Nonn. Desm. Polon. 1885, p. 83, t. 11, f. 1.
C. Raciborskianum De Toni, Syll. Alg. 1889, p. 975.
Ursinella Raciborskiana Kuntze, Revis. gen. plant. 1891, p. 925.

Length 33–35 μ; breadth 35 μ; breadth of isthmus 12–14 μ; thickness 19 μ.

Ireland.—Creggan Lough, Galway!

Geogr. Distribution.—Poland.

5. **Cosmarium Lundellii** Delp.

(Pl. LVII, figs. 1, 2).

Cosmarium Lundellii Delp. Desm. subalp. 1877, p. 13, t. 7, f. 62-64; Wille, Norges Ferskv. Alg. 1880, I, p. 33; Sydamerik. Algfl. 1884, p. 47, t. 3, f. 89 ("forma"); De Toni, Syll. Alg. 1889, p. 956; Nordst. Index Desm. 1896, p. 160; West & G. S. West, Freshw. Alg. Ceylon, 1902, p. 162.
Ursinella Lundellii Kuntze, Revis. gen. plant. 1891, p. 925.
Cosmarium subcirculare Turn. Freshw. Alg. E. India, 1893, p. 52, t. 8, f. 3; t. 9, f. 27, 37.

Cells large, subcircular, about as long as broad (or a little longer), deeply constricted, sinus linear with a dilated apex; semicells subsemicircular or pyramidate-semicircular, basal angles broadly rounded. Side view of semicell subcircular. Vertical view elliptic, ratio of axes 1 : 1·94, poles slightly drawn out. Cell-wall punctate, generally thickened in the centre of the semicells. Chloroplasts axile, with prominent ridges, and with two large pyrenoids.

Zygospore unknown.

Length 79–88 μ; breadth 69–79 μ; breadth of isthmus 30–41 μ; thickness 42–45 μ.

England.—Mousehole Cave, Cornwall!

Geogr. Distribution.—Germany. Galicia in Austria. Italy. Norway. Poland. Central China (forma). India. Central and E. Africa. Madagascar. Brazil. Ecuador. Argentina.

This species is much more abundant in the tropics than in temperate climates, and quite a number of distinct varieties of it exist. It differs from *C. Ralfsii* Bréb. in its somewhat smaller size, its less deep constriction and consequently broader isthmus, in the more rounded basal angles of the semicells, and in its axile chloroplasts.

The breadth of the isthmus as compared with the breadth of the semicell is as 1 : 4·3 in *C. Ralfsii*, whereas in *C. Lundellii* it is only 1 : 2·5.

Var. **ellipticum** West. (Pl. LVII, figs. 3, 4.)

C. Lundellii var. *ellipticum* West, New Brit. Freshw. Alg. 1894, p. 5, t. 1, f. 11.

Cells smaller than in the type, about $1\frac{1}{3}$ times longer than broad, with a narrower isthmus.

Length 68–73 μ; breadth 53–55 μ; breadth of isthmus 16–21 μ; thickness 26–29 μ.

Wales.—Snowdon, Carnarvonshire (at 3,000 ft.) !

Scotland.—Ben Laoigh, Perthshire !

Compared with its breadth this variety is proportionately longer than any of the other varieties of *C. Lundellii*.

Var. **corruptum** (Turn.) West & G. S. West. (Pl. LVII, figs. 5, 6.)

Cosmarium corruptum Turn. Freshw. Alg. E. India, 1893, p. 51, t. 8, f. 2.
C. subcirculare Turn. var. *rugosum* Turn. l. c. p. 52, t. 8, f. 7.
C. rotundum Turn. l.c. p. 58, t. 8, f. 48.
C. Lundellii Delp. var. *corruptum* (Turn.) West & G. S. West, Freshw. Alg. Ceylon, 1902, p. 162.

Cells smaller, sinus often somewhat open towards the exterior; cell-wall with variable scrobiculations of small size, generally larger and more distinct near the margin; apex of semicells slightly subtruncate.

Length 51–63 μ; breadth 48·5–61 μ; breadth of isthmus 23–28·5 μ.

England.—Bowness, Westmoreland!

Geogr. Distribution.—Galicia in Austria. India. Ceylon.

This variety only differs from typical *C. Lundellii* in its somewhat smaller size and in the greater distinctness of the scrobiculations near the margins of the semicells. The sinus is generally closed in its median part, although dilated at its extremity and opening considerably towards the exterior.

The plants named by Turner *Cosmarium corruptum, C. subcirculare* var. *rugosum,* and *C. rotundum,* are most certainly forms of one species, and we have thought it best to place them as a variety of *C. Lundellii* under the name "*corruptum.*"

C. Lundellii var. *corruptum* should be compared with *C. galeritum* Nordst., from which it can be distinguished by its wider and more depressed semicells, with less truncate apices, and by its much broader isthmus.

6. **Cosmarium pachydermum** Lund. (Pl. LVII, fig. 7.)

Cosmarium pachydermum Lund. Desm. Suec. 1871, p. 39, t. 2, f. 15; Kirchn. Alg. Schles. 1878, p. 149; Wolle, Desm. U.S. 1884, p. 70, t. 15,

f. 2-4; Cooke, Brit. Desm. 1886, p. 85, t. 37, f. 1; Hansg. Prodr. Algenfl. Böhm. 1888, p. 198; De Toni, Syll. Alg. 1889, p. 970; West, Alg. W. Ireland, 1892, p. 144; Alg. Eng. Lake Distr. 1892, p. 724; Roy & Biss. Scott. Desm. 1894, p. 170; Nordst. Index Desm. 1896, p. 193; West & G. S. West, Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 69.
C. pachydermum a. *typicum* Klebs, Desm. Ostpreuss. 1879, p. 34, t. 3, f. 36.
Ursinella pachyderma Kuntze, Revis. gen. plant. 1891, p. 925.

Cells large, broadly elliptic, about $1\frac{1}{3}$ times as long as broad, deeply constricted, sinus narrowly linear with a dilated apex; semicells widely semi-elliptic, apices broad, basal angles broadly rounded, lower part of sides at first somewhat straight. Side view of semicell subcircular. Vertical view elliptic, ratio of axes about 1 : 1·5. Cell-wall thick and densely punctate. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 78–117 μ; breadth 60–87 μ; breadth of isthmus 30–40 μ; thickness 50–59 μ; thickness of cell-wall 2·5–3 μ.

England.—Foot of Brant Fell, Westmoreland! Malham Tarn and Penyghent, W. Yorks! Pilmoor near Thirsk, N. Yorks! Mitcham Common and near Chapel Wood, Surrey! Millford Lake, Hants (*Roy*). Near Bovey Tracey, Devon (*Bennett*). Tremethick Moor, Cornwall!

Scotland.—Sutherland, Ross, Aberdeen, Kincardine, Stirling, Argyll (in Mull) (*Roy & Bissett*).

Ireland.—Lough Aunierin, Galway! Dublin and Wicklow (*Archer*). Clough, Antrim!

Geogr. Distribution.—France. Germany. Austria and Galicia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. N. and S. Russia. Faeroes. Japan. Sumatra. Java. New Zealand. Australia. Azores. United States. Brazil. Argentina. Patagonia.

C. pachydermum is readily distinguished from *C. Lundellii* by its inflated semicells and its thick cell-wall. The vertical view is also more elliptic.

Var. **æthiopicum** *nob.* (Pl. LVII, figs. 8, 9.)

C. Lundellii var. *æthiopicum* West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 32; Scott. Freshw. Plankton, I, 1903, p. 526, 541.

Cell-wall much thinner than in the type, finely scrobiculate and minutely punctate between the scrobiculations.

Length 69–107 μ; breadth 61–80 μ; breadth of isthmus 28–33 μ; thickness 40–44 μ.

Scotland.—Plankton of Loch Shin, Sutherland!

Geogr. Distribution.—W. Africa.

This variety was at first erroneously referred to *C. Lundellii*, but the form of the semicells both in the front and vertical view shows clearly that it is a thin-walled variety of *C. pachydermum*.

Careful examination of the cell-wall of this variety reveals a large number of minute punctulations scattered between the larger ones.

7. **Cosmarium Ralfsii** Bréb.

(Pl. LVII, fig. 10; Pl. LVIII, figs. 1, 2.)

Cosmarium Ralfsii Bréb. in Ralfs' Brit. Desm. 1848, p. 93, t. 15, f. 3; Arch. in Pritch. Infus. 1861, p. 731; Rabenh. Flor. Europ. Alg. 1868, III, p. 161; Lund. Desm. Suec. 1871, p. 52; Nordst. Norges Desm. 1873, p. 25; Wolle, Desm. U.S. 1884, p. 69, t. 15, f. 1; Cooke, Brit. Desm. 1886, p. 85, t. 36, f. 12; Hansg. Prodr. Algenfl. Böhm. 1888, p. 193; West, Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 163; Alg. Eng. Lake Distr. 1892, p. 729; Roy & Biss. Scott. Desm. 1894, p. 173; Nordst. Index Desm. 1896, p. 220; West & G. S. West, Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 68; Alg. N. Ireland, 1902, p. 33.

Didymidium (*Cosmarium*) *Ralfsii* Reinsch, Algenfl. Frank. 1867, p. 108.

Cosmarium Ralfsii a. *typicum* Klebs, Desm. Ostpreuss. 1879, p. 33, t. 3, f. 33–35, 37; Racib. Nonn. Desm. Polon. 1885, p. 70.

Cosmaridium Ralfsii Hansg. Prodr. Algenfl. Böhm. 1888, p. 246.

Pleurotæniopsis (*Cosmaridium*) *Ralfsii* (Bréb.) De Toni, Syll. Alg. 1889, p. 911.

Cells large, subcircular, a little longer than broad, very deeply constricted, sinus narrowly linear with a dilated apex; semicells subpyramidate-semicircular, basal angles rounded, sides slightly convex, apex broadly rounded or truncately rounded. Side view of semicell subcircular. Vertical view rhomboid-elliptic, ratio of axes about 1 : 1·9. Cell-wall finely punctate or even scrobiculate, sometimes almost smooth. Chloroplasts parietal, consisting of several irregular bands

running from base to apex of each semicell, each band with several rather small pyrenoids.

Zygospore unknown.

Length 112–120 μ; breadth 95–104 μ; breadth of isthmus 21–25 μ; thickness 50 μ.

England.—Cumberland! Westmoreland! (*Bissett*). W. and N. Yorks! Lancashire! Norfolk (*Cooke*). Warwick (*Wills*). Surrey! Sussex (*Ralfs*). Kent (*Ralfs*). Hants! (*Ralfs*). Devon! (*Bennett*).

Wales.—General in Carnarvonshire (up to 2,700ft. on Glyder Fawr)! Dolgelly and Ffestiniog, Merioneth! Llyn Coron, Anglesey!

Scotland.—Sutherland!, Ross, Inverness!, Aberdeen, Kincardine, Forfar, Perth!, Argyll, Arran (*Roy & Bissett*). Outer Hebrides! Orkneys!

Ireland.—Widely distributed in Donegal, Galway, and Kerry! Mayo! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Belgium. Germany. Galicia in Austria. Hungary. Norway. Sweden. N. Russia. Poland. Azores (var.). United States.

This characteristic species is widely distributed in the upland districts of the British Islands, and often occurs in abundance among submerged *Sphagnum*. It is frequently associated with *Cosmarium Cucurbita, Euastrum insigne, Micrasterias oscitans* var. *mucronata, M. truncata, Gymnozyga moniliformis, Tetmemorus granulatus,* and *Netrium Digitus.*

It is characterized by its pyramidate-semicircular semicells with a rounded apex, by its deep constriction, and by the parietal chloroplasts. The cell-wall is generally finely punctate, but may be delicately scrobiculate, and old individuals often become quite asperulate on the exterior.

Wolle gives a minimum length of 70 μ and a minimum breadth of 60 μ for his American specimens, but we have not seen any British forms so small as this.

Var. **montanum** Racib. (Pl. LVIII, fig. 3.)

Cosmarium Ralfsii var. *montanum* Racib. Nonn. Desm. Polon. 1885, p. 70, t. 10, f. 4; West, Alg. W. Ireland, 1892, p. 163.

Pleurotæniopsis Ralfsii var. *montana* (Racib.) De Toni, Syll. Alg. 1889, p. 911.

Cells with the sinus opening outwards, basal angles of semicells less rounded and slightly produced.

Length 87–128 μ; breadth 76–101 μ: breadth of isthmus 20–23 μ.

Ireland.—Carrantuohill, Kerry!

Geogr. Distribution.—Galicia in Austria. Poland.

8. **Cosmarium perforatum** Lund.

(Pl. LVIII, figs. 4, 5.)

Cosmarium perforatum Lund. Desm. Suec. 1871, p. 40, t. 2, f. 16; Wolle, Freshw. Alg. U.S. 1887, p. 28, t. 57, f. 32; De Toni, Syll. Alg. 1889, p. 977; West, Alg. W. Ireland, 1892, p. 144; Alg. Eng. Lake Distr. 1892, p. 724; Lütkem. Desm. Attersees, 1893, p. 556; Roy & Biss. Scott. Desm. 1894, p. 171; Nordst. Index Desm. 1896, p. 199; West & G. S. West, Alg. N. Ireland, 1902, p. 33.

Ursinella perforata Kuntze, Revis. gen. plant. 1891, p. 925.

Cosmarium perforatum a. *typicum* Gutw. Flor. Glon. Okolic Lwowa, 1891, p. 48.

Cells of medium size, angular-subcircular, a little longer than broad, moderately constricted, sinus somewhat open, widening outwards from an acute apex; semicells subpyramidate-semicircular, basal angles rounded-truncate, sides almost straight for a short distance, then converging to the subtruncate or subretuse apex. Side view of semicell subcircular, broad at the base and slightly retuse at the apex. Vertical view elliptic with pointed poles, ratio of axes about 1 : 1·56. Cell-wall rather thick, punctate, with a subtriangular area in the centre of the semicells near the isthmus furnished with about 20 small scrobiculations. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 60–75 μ; breadth 57–63 μ; breadth of isthmus 26–36 μ: thickness 38–40 μ.

England.—Bowness, Westmoreland!

Scotland.—Loch Ruthven, Inverness; Dalbagie and Loch Ullachie near Ballater, near Castleton, and Birsemore, Aberdeen (*Roy & Bissett*). Dumfries!

Ireland.—Loughs Akibbon, Gartan, and Sproule, Donegal! Ballynahinch, Lough Derryclare, Lakes E. of Lough Bofin, and small lakes Clifden to Roundstone, Galway!

Geogr. Distribution.—France. Germany. Austria and Galicia. Norway. Sweden. Bornholm. N. and S. Russia. Faeroes. Greenland. United States.

The species is well characterized by the outward form of the semicells, the open sinus and broad isthmus, as well as by the large, scattered scrobiculations in the centre of the semicells.

9. **Cosmarium ocellatum** Eichler & Gutw.

(Pl. LVIII, fig. 6.)

Cosmarium ocellatum Eichl. & Gutw. Nonn. Spec. Alg. Nov., 1894, p. 164, t. 4, f. 7.

Cells small, $1\frac{1}{6}$–$1\frac{1}{4}$ times as long as broad, deeply constricted, sinus linear and dilated towards the apex; semicells subsemicircular-pyramidate, basal angles and apex rounded. Side view of semicell subcircular. Vertical view elliptic, ratio of axes about 1 : 2·25. Cell-wall smooth or very finely punctate, with a large scrobiculation in the centre of the semicells. Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 20–30 μ; breadth 17–23 μ; breadth of isthmus 4–6 μ; thickness 9–14 μ.

Geogr. Distribution.—Galicia in Austria.

The typical form of this species has not yet been observed in the British Islands.

Var. **incrassatum** West & G. S. West. (Pl. LVIII, fig. 7.).

C. ocellatum var. *incrassatum* West & G. S. West, Alg. S. England, 1897, p. 485, t. 6, f. 12.

A variety with the sinus always open; semicells with subtruncate apices. Cell-wall in the centre of the semicells with a thickened area of a yellowish colour, containing a small central scrobiculation surrounded by 2–5 smaller ones. Vertical view elliptic, with a slight, flattened protuberance at the middle on each side.

Length 28–30 μ; breadth 24–26 μ; breadth of isthmus 5·5–6·5 μ; thickness 14·5–15 μ.

England.—Thursley Common, Surrey! New Forest, Hants!

This variety was abundant among *Utricularia minor* in both the above-mentioned localities.

10. **Cosmarium cyclicum** Lund.

(Pl. LVIII, figs. 8, 9.)

Cosmarium cyclicum Lund. Desm. Suec. 1871, p. 35, t. 3, f. 6; Cooke, Brit. Desm. 1886, p. 116, t. 40, f. 11; Hansg. Prodr. Algenfl. Böhm. 1888, p. 196; De Toni, Syll. Alg. 1889, p. 983; West, Alg. N. Yorks. 1889, p. 293; Alg. N. Wales, 1890, p. 290; Alg. Eng. Lake Distr. 1892, p. 728; Nordst. Index Desm. 1896, p. 94; West & G. S. West, Alga-fl. Yorks. 1900, p. 69.

C. Turnerianum Mask. Further Notes N. Zeal. Desm. 1889, p. 18, t. 3, f. 28.

Ursinella cyclica Kuntze, Revis. gen. plant. 1891, p. 924.

Cells of medium size, circular or transversely circular-elliptic, about as long as broad, deeply constricted, sinus very narrow with a dilated apex; semicells semicircular, angles slightly rounded or obliquely truncate, margin regularly crenate with about 12 crenæ, and with two or three parallel rows of small undulations within the margin. Side view of semicell obcuneate, apex rounded-truncate. Vertical view narrowly fusiform-elliptic, undulate towards the poles, ratio of axes about 1 : 2·2. Cell-wall smooth. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 49–52 μ; breadth 52–58 μ; breadth of isthmus 17–27·5 μ; thickness 25–26 μ.

England.—Borrowdale, Cumberland! Near Bowness (*Bissett*), and Helvellyn!, Westmoreland! Mickle Fell, N. Yorks!

Wales.—Capel Curig (*Cooke & Wills*), Snowdon!, Llyn Idwal!, Y Foel Fras!, and Llyn-an-afon!, Carnarvonshire.

Ireland.—Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Austria

and Bohemia (var.). Italy. Norway. Sweden. Greenland. Spitzbergen. Nova Zembla. United States.

C. cyclicum Lund. differs from *C. undulatum* Corda in its more depressed semicells with less rounded basal angles, and in the possession of two pyrenoids in each chloroplast.

Var. **arcticum** Nordst. (Pl. LVIII, fig. 10.)

C. cyclicum Lund. subsp. *arcticum* Nordst. Desm. Spetsb. 1872, p. 31, t. 6, f. 13; Desm. Ital. 1876, p. 37; Boldt, Desm. Grönl. 1888, p. 22; De Toni, Syll. Alg. 1889, p. 983; Roy & Biss. Scott. Desm. 1894, p. 44; Börg. Freshw. Alg. Östgrönl. 1894, p. 15.
C. cyclicum Lund. var. *maculatum* Schmidle, Weit. Beitr. Algenfl. Rheineb. u. Schwarzwald. 1895, p. 76, t. 1, f. 7.

Cells subcircular, inclined to be somewhat sexangular; semicells with the crenæ of the margin and within the margin bigranulate (as if emarginate), those towards the base unigranulate, apex 4-crenate and without granules.

Length 57·5–75 μ; breadth 65–75 μ; breadth of isthmus 22–28 μ; thickness 33–37 μ.

Scotland.—Aberdeen, Kincardine, Forfar, and Renfrew (*Roy & Bissett*).

Geogr. Distribution.—Galicia and Bohemia in Austria. Italy. Norway. Bornholm. Poland. Faeroes. Greenland. Spitzbergen. Nova Zembla.

The figure of this variety given by Roy and Bissett is not like that of Nordstedt's, but it suggests var. *arcticum* in the minute binate granules. We give a copy of Roy & Bissett's figure (Pl. LVIII, fig. 11), and we think it stands near to var. *Nordstedtianum*, as the granules are not evident at the margin.

The form described by Schmidle as "var. *maculatum*" is intermediate in character between the figure given by Nordstedt and that given by Roy & Bissett.

Var. **Nordstedtianum** (Reinsch) *nob.* (Pl. LVIII, fig. 12.)

Cosmarium Nordstedtianum Reinsch, Contrib. Alg. et Fungi, 1875, p. 89, t. 10, f. 11.
C. cyclicum Lund. var. *angulatum* West, Alg. N. Yorks. 1889, p. 293, t. 291, f. 2; Alg. Eng. Lake Distr. 1892, p. 728; West & G. S. West, Alga-fl. Yorks. 1900, p. 69.

Ursinella Nordstedtiana Kuntze, Revis. gen. plant. 1891, p. 925.
C. cyclicum Lund. var. *truncatum* Borge, Süssw. Chlor. Archang. 1894, p. 21; [*vide* West in Journ. Bot. 1895, p. 67.]

Cells distinctly hexagonal, usually a little broader than long; apices truncate or subtruncate, less crenate than the lateral margins.

Length 48–50 μ; breadth 54–66 μ; breadth of isthmus 19–21 μ; thickness 20–23 μ.

England.—Borrowdale, Cumberland! Penyghent, W. Yorks! Mickle Fell, N. Yorks! Wimbledon Common, Surrey.

Ireland.—Fintown, Donegal!

Geogr. Distribution.—Galicia in Austria. N. Russia.

We have observed this variety in greater abundance than typical *C. cyclicum*. It is well characterized by its hexagonal cells with truncate apices.

11. **Cosmarium fontigenum** Nordst.
(Pl. LIX, figs. 16, 17.)

Cosmarium fontigenum Nordst. in Wittr. & Nordst. Alg. Exsic. 1878, no. 171; and in fasc. 21 (1889), p. 43 cum fig. xylogr.; De Toni, Syll. Alg. 1889, p. 1010; Roy & Biss. Scott. Desm. 1894, p. 101; West & G. S. West, Alg. S. England, 1897, p. 486.
Ursinella fontigena Kuntze, Revis. gen. plant. 1891, p. 924.

Cells small, about as long as broad, deeply constricted, sinus very narrow with a slightly dilated extremity; semicells broadly subpyramidate, apex broadly truncate, basal angles rounded, sides slightly convex or almost straight, upper part of lateral margins slightly crenate. Side view of semicell subcircular. Vertical view narrowly elliptic, with a small protuberance at the middle on each side. Cell-wall finely punctate. Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 20–26 μ; breadth 20–25 μ; breadth of isthmus 6–8 μ; thickness 11–13 μ; breadth of apices about 8–11 μ.

England.—Puttenham Common, Surrey!

Scotland.—Ross; Skye and near Brin, Inverness; Aberdeen; Kincardine; Perth (*Roy & Bissett*).

Ireland.—Dublin and Wicklow (*Archer*).

Geogr. Distribution.—Germany (forma). Norway. Sweden. Bornholm.

Gutwinski has described a Desmid from Galicia which he named *C. pseudofontigenum* (*vide* Gutw. 'Wahr. d. Priorität,' 1890, p. 67; 'Flor. Glon. Okolic Lwowa,' 1891, p. 40, t. i, f. 11), but we do not see how it can be specifically separated from *C. fontigenum* Nordst. as it only differs in the reduction of the small central protuberance. In dimensions and in all other characters it agrees well with *C. fontigenum* and therefore it can only be considered as a form of it.

12. **Cosmarium undulatum** Corda.

(Pl. LIX, figs. 1–3, 5.)

Cosmarium undulatum Corda in Alm. de Carlsbad, 1839, p. 243, t. 5, f. 26; Ralfs, Brit. Desm. 1848, p. 97, t. 15, f. 8; Arch. in Pritch. Infus. 1861, p. 732, t. 2, f. 33, 34; Rabenh. Flor. Europ. Alg. III, 1868, p. 165; Lund. Desm. Suec. 1871, p. 35; Kirchn. Alg. Schles. 1878, p. 149; Wolle, Desm. U. S. 1884, p. 67, t. 16, f. 20, 21; Cooke, Brit. Desm. 1886, p. 97, t. 37, f. 16; Hansg. Prodr. Algenfl. Böhm. 1888, p. 196; West, Alg. N. Wales, 1890, p. 289; Alg. W. Ireland, 1892, p. 151; Alg. Eng. Lake Distr. 1892, p. 726; Roy & Biss. Scott. Desm. 1894, p. 177; Nordst. Index Desm. 1896, p. 265; West & G. S. West, Alg. S. England, 1897, p. 488; Alga-fl. Yorks. 1900, p. 73.

Didymidium (*Cosmarium*) *undulatum* Reinsch, Algenfl. Frank. 1867, p. 117 (in part).

Euastrum (*Cosmarium*) *undulatum* Gay, Monogr. loc. Conj. 1884, p. 60.

Ursinella undulata Kuntze, Revis. gen. plant. 1891, p. 925.

Cells rather small, quadrate-elliptic, about $1\frac{1}{3}$–$1\frac{1}{2}$ times as long as broad, deeply constricted, sinus narrow with a dilated extremity; semicells widening upwards near the base, then subsemicircular, margins with 10 to 12 equal undulations. Side view of semicell subcircular. Vertical view elliptic, ratio of axes 1 : 1·33. Cell-wall smooth. Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 54–64 μ; breadth 39–52 μ; breadth of isthmus 12·5–17 μ: thickness 27·5–30 μ.

England.—Westmoreland! (*Ralfs*). W., N., and E. Yorks! Cheshire (*Roy*). Warwick (*Wills*). Gloucester (*Ralfs*). Surrey! Sussex (*Ralfs*). Cornwall! (*Marquand*).

Wales.—Bethesda!, Glyder Fawr and Pen-y-gwryd (*Roy*), Capel Curig! (*Cooke & Wills*), Carnarvonshire. Dolgelly, Merioneth (*Ralfs*). Llyn Coron, Anglesey!

Scotland.—Ross, Inverness!, Banff, Aberdeen, Kincardine, Forfar, Perth!, Argyll (*Roy & Bissett*).

Ireland.—Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Austria and Galicia. Bohemia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland (var.). Lapland. S. Russia. Greenland. Spitzbergen. Afghanistan. Sumatra (var.). Abyssinia. New Zealand. United States.

This species is widely distributed but by no means common. We figure a small form of it (Pl. LIX, fig. 4) which might almost stand as "forma *minor*"; length 34 μ; breadth 27·5 μ; breadth of isthmus 11 μ. Gutwinski has described a "forma *minima*" from Galicia with the following dimensions:—length 17–22 μ; breadth 16–17 μ: breadth of isthmus 5 μ.

Var. **minutum** Wittr. (Pl. LIX, figs. 6, 7.)

C. undulatum Corda var. *minutum* Wittr. Skandinav. Desm. 1869, p. 11, t. i, f. 3: Gotl. Öl. sötv. Alg. 1872, p 59; De Toni, Syll. Alg. 1889, p. 973; Roy & Biss. Scott. Desm. 1894, p. 177.
C. crenatum Ralfs var. *alpinum* Racib. Nonn. Desm. Polon. 1885, p. 76, t. 11, f. 11.
C. alpinum (Racib.) De Toni, Syll. Alg. 1889, p. 942; Schmidle in Hedwigia, 1894, p. 89.
Ursinella alpina Kuntze, Revis. gen. plant. 1891, p. 924.

Cells smaller, about $1\frac{1}{6}$ times longer than broad; semicells subsemicircular, basal angles rounded, margin undulate, with 12–14 undulations.

Length 21–28 μ; breadth 18–21 μ; breadth of isthmus 8·5–10 μ; thickness 12–13 μ.

England.—Strensall Common, N. Yorks! (*Turner*). Leicestershire (*Roy*).

Scotland.—"Not so common as the type" (*Roy & Bissett*).

Ireland.—Foxford, Mayo! Iar Connaught, Galway!

Geogr. Distribution.—Germany. Sweden. Poland.

C. crenatum Ralfs var. *alpinum* Racib. is unquestionably the same Desmid as *C. undulatum* Corda var. *minutum* Wittr., and should without doubt be regarded as a variety of *C. undulatum*. It differs from the typical form of that species in the shape of the semicells and in the more numerous undulations.

Var. **crenulatum** (Näg.) Wittr. (Pl. LIX, figs. 11, 12.)

? *Euastrum crenulatum* Ehrenb. 1839.
E. (*Cosmarium*) *crenulatum* Näg. Gatt. einz. Alg. 1849, p. 120, t. 7A, f. 7.
Cosmarium crenulatum Bréb. Liste Desm. 1856, p. 131; Schmidle, Beitr. Algenfl. Schwarzwald. u. Rheineb. 1893, p. 96, t. 4, f. 9; Beitr. alp. Alg. 1895, p 388.
C. bioculatum Bréb. b. *crenulatum* Rabenh. Flor. Eur. Alg. III, 1868, p. 163; De Toni, Syll. Alg. 1889, p. 933.
C. undulatum Corda var. *crenulatum* (Ehrenb.) Wittr. Skandinav. Desm. 1869, p. 11; Nordst. Desm. Brasil, 1870, p. 210; Wittr. Gotl. Öl. sötv. Alg. 1872, p. 59; Heimerl, Desm. alp. 1891, p. 599.
C. Meneghinii Bréb. forma *crenulata* Richter in Wittr. & Nordst. Alg. Exsic. 1883, no. 566; Hansg. Prodr. Algenfl. Böhm. 1888, p. 195; Hoff in Nordst. Bornh. Desm. 1888, p. 197.

Cells smaller, about $1\frac{1}{3}$ times longer than broad; semicells quadrate-semicircular, with about 8 undulations including the basal angles.

Length 29–30 μ; breadth 22·5–23 μ; breadth of isthmus 7–8·5 μ; thickness 13 μ.

Scotland.—Craig-an-Lochan, Perth!

Geogr. Distribution.—Germany. Bohemia. Switzerland. Sweden. Bornholm. Spitzbergen. India. Brazil.

This variety is distinguished from other forms of *C. undulatum* by the fewer number of undulations on each semicell. In general aspect it closely resembles *C. impressulum* Elfv., a species with which it should be carefully compared.

C. Meneghinii Bréb. forma *tricrenata* Turn. ('Freshw. Alg. E. India,' 1893, p. 71, t. 8, f. 25) is stated by the author to be identical with *Euastrum crenulatum* Näg., but his figure is much nearer a form of *C. impressulum* Elfv.

Var. **Wollei** West. (Pl. LIX, figs. 8–10.)

C. undulatum Corda var. *crenulatum* Wolle, Desm. U. S. 1884, p. 67, t. 16, f. 10, 19; Roy & Biss. Scott. Desm. 1894, p. 177.
C. undulatum Corda var. *Wollei* West. Alg. W. Ireland, 1892, p. 151.

Cells smaller, broadly elliptic, about $1\frac{1}{4}$ times as long as broad; semicells subsemicircular, with 13 or 14 crenations in the margin.

Zygospore globose, furnished with long spines (or processes) with tridentate apices.

Length 32–43 μ; breadth 27–36 μ; breadth of isthmus 10–13·5 μ; diam. zygosp. without spines 34 μ, with spines 44–45 μ.

England.—Near Bristol, Gloucestershire (*Ralfs*).

Ireland.—Near Oughterard, Galway!

Geogr. Distribution.—United States.

This variety is distinguished from all the other forms of *C. undulatum* by the *crenation* of the margin, which is of precisely the same nature as that of *Cosmarium speciosum* Lund. The semicells are not inclined to be subquadrate as in var. *minutum* and var. *crenulatum*.

The zygospore of *C. undulatum* figured by Ralfs in his 'British Desmids,' t. 15, f. 8, most certainly belongs to this variety. The empty semicells which he figures round the zygospore are *crenate*.

13. **Cosmarium subundulatum** Wille.

(Pl. LIX, figs. 13–15.)

Cosmarium undulatum (Corda) Ralfs var. *tumidum* Jacobs. Desm. Danem. 1876, p. 197, t. 8, f. 18; Borge, Chlor. Norska Finmark. 1892, p. 10, t. 1, f. 8.

Cosmarium subundulatum Wille, Norges Ferskv. Alg. 1880, I, p. 27, t. 1, f. 9; Boldt, Desm. Grönl. 1880, p. 17; De Toni, Syll. Alg. 1889, p. 1051; Roy & Biss. Scott. Desm. 1894, p. 175; West & G. S. West, Alga-fl. Yorks. 1900, p. 81.

Ursinella subundulata Kuntze, Revis. gen. plant. 1891, p. 925.

Cosmarium Nuttallii West, Alg. W. Ireland, 1892, p. 151, t. 21, f. 5.

C. undulatum Corda var. *subundulatum* Börg. Freshw. Alg. Östgrönl. 1894, p. 17, t. 1, f. 8; Schmidle, Alg. aus Sumatra, 1895, p. 303, t. 4, f. 9.

Cells of moderate size, $1\frac{1}{2}$ times longer than broad, elliptic, deeply constricted, sinus very narrow, dilated at the apex; semicells semi-elliptic, basal angles rounded, apex commonly a little flattened, margins with about 12 undulations, and with two series of undulations within the margin corresponding to the peripheral ones. Side view of semicell ovate, apex

5-undulate. Vertical view elliptic, ratio of axes about 1 : 1·5, with a broad tumour at the middle on each side, poles 5-undulate. Cell-wall very delicately punctate, and often furnished with a few minute scrobiculations more or less regularly disposed near the margin of the semicells. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 45–60 μ; breadth 32–39 μ; breadth of isthmus 15–16 μ; thickness 23–27 μ.

England.—Angle Tarn, Cumberland! Blea Tarn, Westmoreland! Pilmoor, N. Yorks!

Wales.—Llyn Idwal, Llyn-y-cwm-ffynon, and Capel Curig, Carnarvonshire!

Scotland.—Near Strathpeffer, Ross; Brin, Inverness; Upper Powlair and Slewdrum, Aberdeen; near Kingshouse, Argyll (*Roy & Bissett*). Rhiconich, Sutherland!

Ireland.—Near Foxford, Mayo! Ballynahinch, Lough Athry, Clifden, and near Oughterard, Galway! Adrigole and Castletown, Kerry!

Geogr. Distribution.—Norway. Greenland.

This species differs from *C. undulatum* in its proportionately longer cells, in the semi-elliptic shape of the semicells, and in the presence of the large protuberance in the centre of the semicells. There are usually a few minute scrobiculations near the margin of the semicells, more or less regularly arranged, but rather variable in different individuals and somewhat difficult of observation.

14. **Cosmarium Cucumis** (Corda) Ralfs.

(Pl. LIX, figs. 18–20.)

? ? *Cosmarium Cucumis* Corda in Alm. de Carlsbad, 1835, p. 206, t. 2, f. 27.
Cosmarium Cucumis Ralfs' Brit. Desm. 1848, p. 93, t. 15, f. 2; Arch. in Pritch. Infus. 1861; Rabenh. Flor. Europ. Alg. 1868, III, p. 161; Nordst. Desm. Spetsb. 1872, p. 36; Kirchn. Alg. Schles. 1878, p. 146; Wolle, Desm. U.S. 1884, p. 58, t. 15, f. 6–9; Nordst. Desm. Grönland, 1885, p. 9 [forma *major*]; Cooke, Brit. Desm. 1886, p. 84, t. 36, f. 11; Nordst. Bornh. Desm. 1888, p. 202; West, Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 163; Alg. Eng. Lake Distr. 1892, p. 729; Roy & Biss. Scott. Desm. 1894, p. 44; Nordst. Index Desm. 1896, p. 91; West & G. S. West, Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 69; Alg. N. Ireland, 1902, p. 33.

Euastrum (*Cosmarium*) *Cucumis* Näg. Gatt. einz. Alg. 1849, p. 114.
Didymidium (*Cosmarium*) *Cucumis* Reinsch, Algenfl. Frank. 1867, p. 108.
Cosmarium Cucumis a. *typicum* Klebs, Desm. Ostpreuss, 1879, p. 30, t. 3, f. 11, 12, 15.
Cosmaridium Cucumis Gay, Monogr. loc. Conj. 1884, p. 78, t. 2, f. 19; Hansg. Prodr. Algenfl. Böhm. 1888, p. 190.
Cosmarium Cucumis 2. *anglica* Racib. Nonn. Desm. Polon. 1885, p. 70.
Pleurotæniopsis Cucumis Lagerh. Algol. Bidr. 1887, p. 197.

Cells large, $1\frac{1}{2}$–$1\frac{3}{4}$ times as long as broad, deeply constricted, sinus narrowly linear with a slightly dilated extremity; semicells semi-elliptic or widely truncate-ovate from a broad base, both inferior and superior angles rounded, apex rounded or sometimes slightly truncate. Side view of semicell obtusely ovate. Vertical view broadly elliptic or elliptic-oblong, ratio of axes about 1 : 1·3. Cell-wall smooth. Chloroplasts 6 or 8 in each semicell, forming parietal, irregular bands extending from base to apex, and each containing several pyrenoids.

Zygospore unknown.

Length 62–102 μ; breadth 34–56 μ; breadth of isthmus 20–38 μ; thickness 27–38 μ.

England.—Cumberland! Westmoreland (up to 2,400 ft.)! (*Ralfs*). W., N., and E. Yorks! Lancashire! Essex! Oxfordshire! Warwick (*Wills*). Gloucester (*Ralfs*). Surrey! Sussex (*Ralfs*). Hants (*Bennett*). Devon (*Bennett*). Cornwall!

Wales.—Snowdon!, Capel Curig! (*Cooke & Wills*), Llyn Idwal!, Llyn Ogwen!, Bethesda!, Llyn-an-afon!, Moelfre!, and Yr Orsedd!, Carnarvonshire.

Scotland.—General! (*Roy & Bissett*). Outer Hebrides! Orkneys! Shetlands!

Ireland.—Donegal! Galway! Kerry! Dublin and Wicklow! (*Archer*). Down!

Geogr. Distribution.—France. Germany. Switzerland. Austria and Galicia. Poland. Hungary. Italy. Portugal. Norway. Sweden. Denmark. Bornholm. Finland. N. and S. Russia. Greenland. Spitzbergen. Nova Zembla. Siberia. Iceland. Faeroes. Azores. Burmah. Porto Rico. Brazil. Uruguay. Patagonia.

C. Cucumis is somewhat variable both in size and in its

relative proportions. In the typical form the apices of the semicells are very slightly (almost inappreciably) flattened and the sinus is fairly deep.

The chloroplasts are very characteristic. They are parietal bands similar to those present in *C. Ralfsii*, but are broader with more serrated edges. The number of bands in each semicell is not constant, and each band possesses several small ellipsoidal pyrenoids.

In the 'Alg. of W. Ireland' p. 163, the zygospores of *C. Cucumis* were described as "globose and smooth," but we are now uncertain as to the identity of the species in question. It may have been *C. Subcucumis* or some other allied form, as the measurements (length 54–57 μ; breadth 30–31 μ) are not those of typical *C. Cucumis*.

Var. **helveticum** Nordst.

C. Cucumis var. *helveticum* Nordst. in Wittr. & Nordst. Alg. Exsic. 1880, No. 378; and in fasc. 21, 1889, p. 43; Roy & Biss. Scott. Desm. 1894, p. 44.

Cells smaller, semicells more rapidly attenuated towards the apex; cell-wall densely and minutely scrobiculate.

Length 48–56 μ; breadth 26–36 μ; breadth of isthmus 10–12 μ; thickness 22–26 μ.

England.—Delamere, Cheshire (*Roy*). Leicestershire (*Roy*).

Wales.—Glyder Fawr and Pen-y-gwryd, Carnarvonshire (*Roy*).

Scotland.—Inverness, Aberdeen, Kincardine (*Roy & Bissett*).

Geogr. Distribution.—Switzerland.

We have not seen this variety. Nordstedt states that it strongly resembles *C. subquadratum* Nordst. and *C. variolatum* Lund.

Var. **magnum** Racib. (Pl. LIX, figs. 21, 22.)

C. Cucumis "forma major non tam profunde constricta quam anglica, membrana crassa," Nordst. Desm. Arctoæ, 1875, p. 29, t. 8, f. 28; Boldt, Desm. Grönland, 1888, p. 11; Börg. Bornholm. Desm.-fl. 1889, p. 146; Roy & Biss. Scott. Desm. 1894, p. 44.

C. Cucumis 5. *magna* Racib. Nonn. Desm. Polon. 1885, p. 70; West & G. S. West, Freshw. Alg. Orkneys and Shetlands, 1905, p. 15 (sep.).

A large variety, almost twice as long as broad, and less deeply constricted than the type; semicells with truncate or subtruncate apices; cell-wall densely punctate, often thick.

Length 98–107 μ; breadth 53–66 μ; breadth of isthmus 33–43 μ; thickness 38·5–46 μ.

England.—Helvellyn, Westmoreland!

Scotland.—"Pretty common" (*Roy & Bissett*). Skye, Inverness! W. of Kirkwall, Orkneys!

Geogr. Distribution.—Bornholm. Spitzbergen. Greenland.

15. **Cosmarium Subcucumis** Schmidle.

(Pl. LX, figs. 1–3.)

Cosmarium subcucumis Schmidle, Beitr. Algenfl. Schwarzwald. u. Rheineb. 1893, p. 98, t. 4, f. 20–22; Nordst. Index Desm. 1896, p. 244; West & G. S. West, Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 69.

Cells large, broadly elliptic, about $1\frac{2}{5}$ to $1\frac{3}{4}$ times as long as broad, deeply constricted, sinus linear and dilated towards the extremities (sometimes slightly open); semicells semi-elliptic, basal angles rounded, apex convex or somewhat flattened. Side view of semicell broadly elliptic. Vertical view elliptic, ratio of axes about 1 : 1·5. Cell-wall smooth. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 54–78 μ; breadth 36–45 μ; breadth of isthmus 15–19 μ; thickness 23–26 μ.

England.—Ogden Clough, Ilkley, and Cautley Spout, W. Yorks! Esher West-end and Wimbledon Commons, Surrey!

Geogr. Distribution.—Germany. Galicia in Austria.

The British specimens are not precisely like those originally described by Schmidle from Germany. The cells are relatively longer and the sinus is generally slightly open. The relative proportion of breadth to length in the British specimens is 1 : 1·79; that in the German specimens is 1 : 1·42.

The species differs from *C. Cucumis* in its axile chloroplasts, each of which contains two rather large pyrenoids.

We give a figure of a rather peculiar specimen (Pl. LX, fig. 4) in which the chloroplasts were neither axile nor parietal, but in an intermediate condition. In the shorter semicell the chloroplasts suggest a parietal disposition, whereas in the longer semicell there is an axile disposition. The external features of this specimen are also more in agreement with those of *C. Cucumis*.

16. **Cosmarium microsphinctum** Nordst.
(Pl. LX, figs. 5–8.)

Cosmarium microsphinctum Nordst. Desm. Ital. 1876, p. 33, t. 12, f. 9; Wolle, Freshw. Alg. U.S. 1887, t. 60, f. 20, 21; Boldt, Desm. Grönl. 1888, p. 11; De Toni, Syll. Alg. 1889, p. 1005; West, Alg. Eng. Lake Distr. 1892, p. 724, t. 9, f. 32; Lütkem. Desm. Attersees, 1893, p. 551; Roy & Biss. Scott. Desm. 1894, p. 168; Börg. Freshw. Alg Östgrönland, 1894, p. 16, t. 1, f. 6; Nordst. Index Desm. 1896, p. 170; West & G. S. West, Alga-fl. Yorks. 1900, p. 70.

Ursinella microsphincta Kuntze, Revis. gen. plant, 1891, p. 925.

Dysphinctium microsphinctum (Nordst.) Schmidle, Alg. Sumatra, 1895, p. 302.

Cells small, elliptic, about $1\frac{1}{2}$ times longer than broad, moderately constricted, sinus uniformly narrow and linear; semicells semi-elliptic, sides convex, gradually converging from an almost straight base to a rounded apex, basal angles subrectangular. Side view of semicell ovate. Vertical view rhomboid-elliptic, poles very slightly produced, ratio of axes about 1 : 1·38. Cell-wall very finely punctate. Chloroplasts axile, each with one pyrenoid.

Zygospore globose, furnished with processes arising from broad bases; apices of processes bifurcate or trifurcate.

Length 36–39·5 μ; breadth 25–27 μ; breadth of isthmus 14·5–18 μ; thickness 18–20 μ; diam. zygosp. without spines 20 μ, with spines 54 μ.

England.—Heseltine Ghyll, Penyghent, and near Ilkley, W. Yorks! Mickle Fell, N. Yorks!

Scotland.—Ardtannes near Inverurie, Craigendinnie near Aboyne, and Presswhin in Cromar, Aberdeen (*Roy & Bissett*).

Geogr. Distribution. — France. Germany (var.). Austria and Galicia. Italy. Faeroes. Greenland. Nova Zembla. Franz Joseph Land. United States.

This is a characteristic species which occurs amongst mosses on wet rocks in mountainous or alpine areas. In the British Islands it appears to be very rare.

It is distinguished from *C. pseudopyramidatum* Lund. and *C. variolatum* Lund. by its much shallower constriction, its rounded apices, its more densely punctate cell-wall, and by the tumour at each side of the vertical view.

Forma **parvula** Wille. (Pl. LX, fig. 9.)

C. microsphinctum Nordst. forma *parvula* Wille, Ferskv. Alg. Nov. Semlj. 1879, p. 38. t. 12, f. 22; Roy & Biss. Scott. Desm. 1894, p. 168.

Cells a little smaller and proportionately a little longer; semicells more attenuated to a narrower apex.

Length 33 μ; breadth 20 μ; breadth of isthmus 7 μ; thickness 15 μ.

Scotland.—Kemback near St. Andrews, Fife (*Roy & Bissett*).

Geogr. Distribution.—Nova Zembla.

Var. **majus** Roy & Biss. (Pl. LX, fig. 10.)

C. microsphinctum Nordst. var. *majus* Roy & Biss. Scott. Desm. 1894, p. 168, t. 4, f. 7.

About twice the size of the ordinary form.

Length 80 μ; breadth 52 μ; breadth of isthmus 35 μ.

Scotland.—Presswhin in Cromar, Aberdeen (*Roy & Bissett*).

17. **Cosmarium morsum** West.

(Pl. LX, fig. 11.)

Cosmarium morsum West, Alg. Eng. Lake Distr. 1892, p. 729, t. 9, f. 10; Nordst. Index Desm. 1896, p. 176.

Cells rather small, almost twice as long as broad, slightly constricted, sinus widely open and semicircular; semicells semi-elliptic, basal angles rectangular. Side view of semicell subcircular, with the sides somewhat compressed. Vertical view very broadly elliptic, ratio of axes about 1 : 1·2. Cell-wall smooth.

Zygospore unknown.

Length 40·5 μ; breadth 23·2 μ; breadth of isthmus 15·5 μ; thickness 20·2 μ.

England.—Near Bowness, Westmoreland!

This species is characterized by the curious excavated sinus and by its relatively great thickness. We have seen no living specimens of it.

18. **Cosmarium Phaseolus** Bréb.

(Pl. LX, figs. 12–14.)

Heterocarpella Phaseolus Bréb. in Cheval. microscop. et usage, 1839, p. 272.

Cosmarium Phaseolus Bréb. in Menegh. Synops. Desm. 1840, p. 220; Ralfs, Brit. Desm. 1848, p. 106, t. 32, f. 5; Bréb. Liste Desm. 1856, p. 131; Arch. in Pritch. Infus. 1861, p. 732; Rabenh. Flor. Europ. Alg. III, 1868, p. 166; Kirchn. Alg. Schles. 1878, p. 153; Wolle, Desm. U.S. 1884, p. 81, t. 18, f. 28–32; Cooke, Brit. Desm. 1886, p. 88, t. 37, f. 3; Hansg. Prodr. Algenfl. Böhm. 1888, p. 201; De Toni, Syll. Alg. 1889, p. 1001; West. Alg. N. Wales, 1890, p. 288; Add. Alg. W. Yorks. II, 1891, p. 245; Alg. W. Ireland, 1892, p. 145; Alg. Eng. Lake Distr. 1892, p. 725; Roy & Biss. Scott. Desm. 1894, p. 171; Nordst. Index Desm. 1896, p. 199; West & G. S. West, Alg. S. England, 1897, p. 486; Alga-fl. Yorks. 1900, p. 70; Alg. N. Ireland, 1902, p. 33.

C. Phaseolus a. *typicum* Klebs, Desm. Ostpreuss. 1879, p. 35.

Euastrum (*Cosmarium*) *Phaseolus* Gay, Monogr. loc. Conj. 1884, p. 59.

Ursinella Phaseolus Kuntze, Revis. gen. plant. 1891, p. 925.

Cells small, as long as broad, deeply constricted, sinus narrow with a dilated extremity; semicells rather narrowly reniform. Side view of semicell subcircular, with a slight protuberance at the middle on each side. Vertical view narrowly elliptic, ratio of axes about 1 : 2, with a small protuberance at the middle on each side. Cell-wall minutely punctate. Chloroplasts axile, with one pyrenoid.

Zygospore globose, densely aculeate, aculei arising from broad bases.

Length 29–35 μ; breadth 26–36 μ; breadth of isthmus 9–11 μ; thickness 19–22 μ; diam. zygosp. without spines 33 μ, with spines 47 μ.

England.—Westmoreland (*Bissett*). W., N., and E. Yorks! Middlesex! Surrey! Devon! Cornwall! (*Ralfs*).

Wales.—Capel Curig! (*Cooke & Wills*), Llyn Ogwen!,

and Yr Orsedd!, Carnarvonshire. Dolgelly, Merioneth (*Ralfs*).

Scotland.—Ross, Inverness!, Aberdeen, Kincardine, Forfar!, Perth!, Argyll, Arran, Fife (*Roy & Bissett*). Sutherland! Kirkcudbright!

Ireland.—Donegal! Galway! Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Belgium. Germany. Austria (var.) and Galicia. Poland (var.). Hungary. Bosnia. Italy. Norway. Sweden. Denmark. Bornholm. N. and S. Russia. Siberia. Greenland. Faeroes. Spitzbergen. India. New Zealand. Australia (form). Central and E. Africa. United States. Porto Rico.

C. Phaseolus should be carefully compared with *C. depressum* (Näg.) Lund., *C. subtumidum* Nordst., and varieties of these species. Apart from differences in the form of its semicells, it can be distinguished at once by the small but prominent protuberance on each side of the vertical view.

Wolle observed the zygospore from the United States.

It is a widely distributed species, but in the British Islands it is distinctly rare.

Forma **minor** Boldt. (Pl. LX, fig. 15.)

C. Phaseolus forma *minor* Boldt, Siber. Chlorophy. 1885, p. 102; Desm. Grönland, 1888, p. 15; West and G. S. West, Alg. S. England, 1897, p. 486.

Cells smaller than in the typical form.

Length 20·4–21 μ; breadth 18 μ; breadth of isthmus 5·5–6 μ; thickness 11·5–14·4 μ.

England.—Grimspound, Devonshire!

Geogr. Distribution.—Siberia. Greenland.

Var. **elevatum** Nordst. (Pl. LX, figs. 16, 17.)

C. Phaseolus var. *elevatum* Nordst. Norges Desm. 1873, p. 17, t. 1, f. 5; Desm. Arctoæ, 1875, p. 24; Wille, Sydamerik. Algfl. 1884, p. 31; Boldt, Siber. Chlorophy. 1885, p. 102; Hansg. Prodr. Algenfl. Böhm. 1888, p. 251; Boldt, Desm. Grönland, 1888, p. 15; De Toni, Syll. Alg. 1889, p. 1001; Schmidle, Beitr. Algenfl. Schwarzwald. u. Rheineb. 1893, p. 102, t. 5, f. 11; Roy & Biss. Scott. Desm. 1894, p. 171; Schmidle, Beitr. alp. Alg. 1895, p. 456; West & G. S. West, Alg. N. Ireland, 1902. p. 33.

Semicells generally hexagonal-elliptic, apex truncate-convex.

Length 26·4–28·8 μ; breadth 25·2–30 μ; breadth of isthmus 7–10 μ; thickness 14·4–17 μ.

Scotland.—Near Ballater, Aberdeen; Glen Dye, Kincardine; Rannoch, Perth (*Roy & Bissett*).

Ireland.—Lough Machugh, Donegal (abundant)!

Geogr. Distribution.—Germany. Galicia in Austria (form). Norway. Sweden. Bornholm. Finland. Iceland. Faeroes. Spitzbergen. Uruguay.

This variety very closely resembles *C. subtumidum* Nordst. var. *Klebsii* (Gutw.) W. & G. S. West, especially in the front view, but it can be recognized by the protuberance on each side of the vertical view.

19. **Cosmarium tumidum** Lund.

(Pl. LX, fig. 18.)

Cosmarium tumidum Lund. Desm. Suec. 1871, p. 45, t. 3, f. 16; Wolle, Desm. U.S. 1884, p. 61, t. 15, f. 23; Boldt, Desm. Grönland, 1888, p. 15; De Toni, Syll. Alg. 1889, p. 955; West, Alg. N. Wales, 1890, p. 288; Alg. Eng. Lake Distr. 1892, p. 725; Roy & Biss. Scott. Desm. 1894, p. 177; Nordst. Index Desm. 1896, p. 262.

C. pseudonitidulum Nordst. var. *majus* Reinsch, Contrib. Alg. et. Fung. 1875, p. 88, t. 12, f. 7.

Ursinella tumida Kuntze, Revis. gen. plant. 1891, p. 926.

Cells rather small, a little longer than broad, deeply constricted, sinus narrow, widening outwards; semicells subsemicircular-elliptic, apices broadly convex. Side view of semicell circular. Vertical view elliptic-rhomboid, widely tumid at the middle on each side, ratio of axes about 1 : 1·35. Cell-wall finely punctate, punctulations larger in the centre of the semicells. Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 33–37 μ; breadth 27–32 μ; breadth of isthmus 8–9·5 μ; thickness 23 μ.

Wales.—Capel Curig, Carnarvonshire!

Scotland. — Slewdrum, Upper Powlair, Aboyne, Castleton, and Glen Clunie, Aberdeen; near Menmuir, Forfar; Folotry, Perth (*Roy & Bissett*).

Ireland.—Near Oughterard, Galway!

Geogr. Distribution. — France. Germany (form).

Norway. Sweden. Denmark. Poland. N. Russia. Finland. Greenland. United States.

This rare species stands near to *C. Phaseolus* Bréb., but is distinguished by its proportionately greater length compared with its breadth, by the straighter and less reniform base of the semicells, and by the broadly tumid (ventricose) sides of the vertical view. Lundell also states that the chloroplasts are like those of *C. moniliforme* (Turp.) Ralfs, consisting of a number of lobes radiating from a central pyrenoid.

Forma **subrectangularis** *f. nov.* (Pl. LX, fig. 19.)

Semicells distinctly subrectangular with rounded angles.

Length 32·5 μ; breadth 27·5 μ; breadth of isthmus 11·2 μ; thickness 22 μ.

Ireland.—Ballynahinch, Galway !

This form is characterized by the shape of its semicells as seen in the front view. The punctulations on the cell-wall are larger in the centre of the semicells as in the typical form.

20. **Cosmarium Trafalgaricum** Wittr.

(Pl. LX, fig. 20.)

Cosmarium Trafalgaricum Wittr. in Wittr. & Nordst. Alg. Exsic. 1877, no. 81; and in fasc. 21, 1889, p. 44 cum fig. xylogr.; Cooke, Brit. Desm. 1886, p. 89, t. 43, f. 7 (figure incorrect); De Toni, Syll. Alg. 1889, p. 1054. *Ursinella Trafalgarica* Kuntze, Revis. gen. plant. 1891, p. 925.

Cells small, about $1\frac{1}{5}$ times longer than broad, deeply constricted, sinus linear, widening outwards; semicells subreniform with a rather flattened base, middle of apex emarginate. Side view of semicell spherical, with a small protuberance on each side. Vertical view elliptic, with a protuberance at the middle on each side, ratio of axes (without protuberances) about 1 : 2. Cell-wall smooth.

Zygospore unknown.

Length 24–26 μ; breadth 20–21 μ; breadth of isthmus 6–7 μ; thickness 13–14 μ.

England. — In the fountains, Trafalgar Square, London (*Wittrock*; 1872).

We have not seen this species, nor has it been observed since its original discovery by Wittrock. It seems to be well characterized by its emarginate apices and its small central protuberance. Its nearest ally is perhaps *C. Phaseolus* Bréb.

21. **Cosmarium melanosporum** Arch.

(Pl. LX, figs. 21–23.)

Cosmarium melanosporum Arch. in Ann. Mag. Nat. Hist. 1883, 5th ser. XII, p. 124; Cooke, Brit. Desm. 1887, p. 188; De Toni, Syll. Alg. 1889, p. 1055; Roy & Biss. Scott. Desm. 1894, p. 167, t. 1, f. 14; West & G. S. West, Alg. N. Ireland, 1902, p. 42.
Ursinella melanospora Kuntze, Revis. gen. plant. 1891, p. 167.

Cells small, as long as broad, or sometimes a little longer than broad, deeply constricted, sinus narrow, widening outwards; semicells transversely oblong, basal angles well rounded, upper angles more rounded, apex broadly convex. Side view of semicell circular. Vertical view elliptic, ratio of axes about 1 : 1·7. Cell-wall smooth.

Zygospore globose and smooth, the wall of a very dark brown colour, becoming black.

Length 15–19 μ; breadth 15–19 μ; breadth of isthmus 5–6·7 μ; thickness 7–9·6 μ; diam. zygosp. 23–25·5 μ.

England.—Leicestershire (*Roy*).

Wales.—Bettws-y-coed, Capel Curig, Glyder Fawr, and Pen-y-gwryd, Carnarvonshire (*Roy*).

Scotland.—Generally distributed (*Roy & Bissett*). Outer Hebrides!

Ireland.—Dublin and Wicklow (*Archer*). Lough Derryadd, Armagh!

Roy states that this species conjugates abundantly in Scotland, and may be readily recognized by the smooth, globular, very dark zygospore. We have only seen the zygospores from the Outer Hebrides and from Ireland.

C. melanosporum stands very near to *C. tenue* Arch., but is distinguished by its more inflated semicells and by the dark colour of the zygospore. The constriction is not so deep in *C. melanosporum* as it is in *C. tenue*, and the vertical view is more broadly elliptic.

22. **Cosmarium asphærosporum** Nordst.

(Pl. LX, figs. 24, 25.)

Cosmarium Schliephackeanum Rabenh. forma *spetsbergensis* Nordst. Desm. Arctoæ, 1875, p. 24, t. 7, f. 15; Cooke, Brit. Desm. 1886, p. 92, t. 37, f. 10; Roy & Biss. Scott. Desm. 1894, p. 174.
C. asphærosporum Nordst. in Wittr. & Nordst. Alg. Exsic. 1879, no. 268; fasc. 21, 1889, p. 49; West & G. S. West, Alga.-fl. Yorks. 1900, p. 74.
Ursinella asphærospora Kuntze, Revis. gen. plant. 1891, p. 924.

Cells small, about as long or not quite as long as broad, moderately constricted, sinus widely open, subrectangular with an obtuse apex; semicells broadly cuneate, with a widely-truncate apex and rounded angles. Side view of semicell obovate-subcircular from a broad base. Vertical view subrhomboid-elliptic, with a scarcely-evident, depressed wart at the middle on each side, ratio of axes about 1 : 1·27. Cell-wall smooth and colourless.

Zygospore smooth, subrectangular-oblong, sometimes elliptic or somewhat irregular, angles rounded, longer sides convex in the middle, shorter sides retuse; side view elliptic; end view circular; cell-wall lead-coloured.

Length 10–13 μ; breadth 12–13 μ; breadth of isthmus 7–8 μ; thickness 9–10 μ; length of zygospore 21–22 μ; breadth of zygospore 14–18 μ.

England.—Penyghent, W. Yorks!

Scotland.—Inverness, Aberdeen, Kincardine, Forfar, Perth, Stirling, Argyll; zygospores from Dinnet, Aberdeen, and Kerloch, Kincardine (*Roy & Bissett*).

Geogr. Distribution.—Norway. Sweden. Spitzbergen. Nova Zembla. New Zealand (var.) United States.

This species is distinguished from *C. bioculatum* Bréb. and *C. tenue* Arch. by its much shallower constriction and widely-open sinus, by the subtruncate apices, by the form of the vertical view, and by the characteristic shape of the zygospore. It differs from *C. inconspicuum* West & G. S. West in its relatively greater breadth, its broader, subtruncate apices, its rhomboid vertical view, and its rectangular zygospore.

Var. **strigosum** Nordst. (Pl. LX, figs. 26, 27.)

C. asphærosporum Nordst. var. *strigosum* Nordst. in Wittr., Nordst. et Lagerh. Alg. Exsic. 1896, No. 1264; Bot. Notiser 1897, p. 86, cum fig. xylogr.; West & G. S. West, Alg. S. England, 1897, p. 486.

Cells with a narrower isthmus and consequently with a deeper sinus, apices flatter; vertical view elliptic with no trace of median inflation.

Length 10–11 μ; breadth 8–10 μ; breadth of isthmus 3·5 μ; thickness 5 μ.

England.—Puttenham Common, Surrey!

Geogr. Distribution.—Sweden.

This variety differs from *C. bioculatum* Bréb. in its smaller size, its more open sinus, and its broad, truncate apices. From *C. bioculatum* var. *hians* it is distinguished by its smaller size, its straighter apices, its less-rounded lateral angles, and its smooth cell-wall.

23. **Cosmarium inconspicuum** West & G. S. West. (Pl. LXI, figs. 1, 2.)

Cosmarium inconspicuum West & G. S. West, New and Int. Freshw. Alg. 1896, p. 154, t. 4, f. 45; Alg. S. England, 1897, p. 486; Alga-fl. Yorks. 1900, p. 74; Alg. N. Ireland, 1902, p. 34.

Cells minute, about $1\frac{1}{3}$ times longer than broad, moderately constricted, sinus open, subrectangular, with a rounded apex; semicells transversely elliptic, apices broadly convex, almost subtruncate. Side view of semicell subcircular. Vertical view elliptic, ratio of axes about 1 : 1·7. Cell-wall smooth and colourless. Chloroplasts axile, each with one pyrenoid.

Zygospore ovoid, with a smooth and colourless wall.

Length 13·5–14·6 μ; breadth 9·5–12 μ; breadth of isthmus 4·8–6·5 μ; thickness 7–7·6 μ; diam. zygosp. 14·5–17 μ.

England.—Bog two miles S. of Clapham, W. Yorks! Mitcham Common, Surrey (with zygospores)! Tremethick Moor, Cornwall!

Ireland.—Glendoan and Lough Gartan, Donegal!

This species is a near ally of *C. tenue* Arch., *C. tinctum* Ralfs, and *C. minutissimum* Arch., all of which have smooth

zygospores. It can be recognized from all these species by the form of its cells alone. Its open sinus, rounded at the apex, is characteristic, and the chloroplast is furnished with a number of distinct lobes.

24. **Cosmarium bioculatum** Bréb.

(Pl. LXI, figs. 3–7.)

Heterocarpella bioculata Bréb. Alg. Falaise, 1835, p. 56, t. 7 [in part only].
Cosmarium bioculatum Bréb. in Ralfs' Brit. Desm. 1848, p. 95, t. 15, f. 5 [in part?]; Arch. in Pritch. Infus. 1861, p. 731; Rabenh. Flor. Europ. Alg. III, 1868, p. 163; Delp. Desm. subalp. 1877, p. 1, t. 7, f. 1–4; Kirchn. Alg. Schles. 1878, p. 147; Cooke, Brit. Desm. 1886, p. 89, t. 37, f. 6; Hansg. Prodr. Algenfl. Böhm. 1888, p. 193; De Toni, Syll. Algar. 1889, p. 933; West, Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 146; Alg. Eng. Lake Distr. 1892, p. 725; Roy & Biss. Scott. Desm. 1894, p. 42; Nordst. Index Desm. 1896, p. 61; West & G. S. West, Alg. S. England, 1897, p. 486; G. S. West, Alga-fl. Cambs. 1899, p. 115; West & G. S. West, Alga-fl. Yorks. 1900, p. 73; Alg. N. Ireland, 1902, p. 34; Scott. Freshw. Plankton, I, 1903, p. 526; Further Contrib. Freshw. Plankton Scott. Lochs, 1905, p. 484.
Didymidium (*Cosmarium*) *bioculatum* Reinsch. Algenfl. Frank. 1867, p. 107 [in part].
Cosmarium Phaseolus Bréb. b. *bioculatum* Klebs, Desm. Ostpreuss. 1879, p. 35.
Euastrum (*Cosmarium*) *bioculatum* Gay, Monogr. loc. Conj. 1884, p. 57.
Ursinella bioculata Kuntze, Revis. gen. plant. 1891, p. 924.

Cells minute, about as long as broad, deeply constricted, sinus narrow towards the apex and widening outwards; semicells transversely oblong-elliptic, both base and apex flattened, sides rounded. Side view of semicell subcircular. Vertical view oblong-elliptic, ratio of axes about 1 : 2. Cell-wall smooth and colourless. Chloroplasts axile with one pyrenoid.

Zygospore globose, furnished with conical, blunt spines, from 9 to 11 of which show in the periphery.

Length 15–21 μ; breadth 15–21 μ; breadth of isthmus 4·8–6·7 μ; thickness 6–9·5 μ; diam. zygosp. without spines 15–19 μ; with spines 22·5–28 μ.

England.—Westmoreland! (*Ralfs*). W., N., and E. Yorks! Lancashire! (*Ralfs*). Leicestershire (*Roy*). Cambridgeshire! Warwick (*Wills*). Gloucestershire (*Ralfs*). Middlesex! Surrey (zygospores from Puttenham Common)! Sussex (*Ralfs*). Kent (*Ralfs*). Cornwall!

Wales. — Fairly general in Carnarvonshire and Merioneth !

Scotland.—Sutherland !, Inverness, Aberdeen, Kincardine, Forfar !, Perth ! (*Roy & Bissett*). At 3,500 ft. on Lochnagar, Aberdeen ! Not uncommon in the plankton ! Outer Hebrides ! Orkneys ! Shetlands !

Ireland.—Donegal ! Mayo ! Galway ! Kerry ! Dublin and Wicklow (*Archer*). Londonderry ! Down ! Armagh !

Geogr. Distribution.—France. Germany. Austria and Galicia. Poland. Hungary. Italy. Bosnia. Finland. Norway. Sweden. S. Russia. Siberia. Greenland. Spitzbergen. Nova Zembla. Central China. New Zealand (var.). Central Africa. Azores. United States.

C. bioculatum is one of the most generally distributed of the small, smooth species of the genus. It is distinguished at once from all its allies by the spiny zygospore. The spines are stout, very blunt, and not very numerous, from nine to eleven being visible around the periphery of the spore.

The semicells are somewhat narrowly elliptic or elliptic-oblong, and the sinus is slightly open.

Forma **depressa** Schaarschm. (Pl. LXI, figs. 8, 9.)

C. bioculatum Bréb. forma *depressa* Schaarschm. Magyar. Desm. 1883, p. 270, t. 1, f. 10; De Toni, Syll. Alg. 1889, p. 934; West, Alg. Eng. Lake Distr. 1892, p. 725; Alg. S. England, 1897, p. 486.

Cells subquadrate, with rounded angles, sinus open; semicells transversely oblong with broadly flattened apices; vertical view oblong, sides parallel and poles rounded.

Length 14·5–20 μ; breadth 17–18 μ.

England.—Brother's Water, Westmoreland! Epping Forest, Essex ! Keston Common, Kent !

Geogr. Distribution.—Galicia in Austria. Hungary. New Zealand.

Var. **hians** West & G. S. West. (Pl. LXI, figs. 10, 11.)

C. bioculatum Bréb. var. *hians* West & G. S. West, Alg. S. England, 1897, p. 486, t. 6, f. 24.

Cells with the sinus more open, somewhat conical with a subacute apex; lower margins of semicells convex, apices straight or very slightly retuse. Cell-wall distinctly but minutely punctate.

Length 17–19 μ; breadth 15–18 μ; breadth of isthmus 3·5–4 μ; thickness 7·5–8·5 μ.

England. — Puttenham and Thursley Commons, Surrey!

This variety comes nearest to *C. bioculatum* Bréb. var. *excavatum* Gutw., but is proportionately shorter, with a more acute sinus, and the apices of the cells are straight or slightly retuse. The cell-wall is also distinctly punctate.

25. **Cosmarium tenue** Arch.

(Plate LXI, figs. 12–15.)

Cosmarium tenue Arch. in Quart. Journ. Micr. Sci. 1868, p. 293; Cooke, Brit. Desm. 1886, p. 92; West, Alg. W. Ireland, 1892, p. 147, t. 20, f. 25; Johns. Rare Desm. U.S. I, 1894, p. 288; Nordst. Index Desm. 1896, p. 251; West & G. S. West, Alg. N. Ireland, 1902, p. 34.
C. ellipsoideum Elfv. forma *minor* Anderss. Sverig. Chlor. 1890, p. 16, t. 1, f. 9.

Cells minute, about as long as broad, deeply constricted, sinus linear, opening outwards; semicells transversely elliptic, apices slightly convex. Side view of semicell circular. Vertical view elliptic, ratio of axes about 1 : 1·8. Cell-wall smooth and colourless. Chloroplasts axile, each with one pyrenoid.

Zygospore globose and smooth.

Length 14–16 μ; breadth 13·5–15·5 μ; breadth of isthmus 3·5–4·5 μ; thickness 8·5 μ; diam. zygosp. 22–23 μ.

Ireland.—Lough Derryclare, and lakes E. of Lough Bofin, Galway (with zygospores)! Dublin and Wicklow (*Archer*). Slieve Donard, Down!

Geogr. Distribution.—Germany (form). Galicia in Austria. Sweden. United States.

C. tenue Arch. may very easily be confused with *C. bioculatum* Bréb., but the semicells are more elliptic and the zygospore is quite smooth.

The Desmid figured by Wolle ('Desm. U.S.' 1884, t. 15, f. 22) as *C. bioculatum* is most probably a form of *C. tenue* as it has a smooth zygospore. Johnson ('Rare Desm. U.S.' I, 1894, p. 288) also states that *C. tenue* is common almost everywhere in the United States, and is often found in quantity and usually with zygospores.

26. **Cosmarium tinctum** Ralfs.

(Pl. LXI, figs. 16–18.)

Cosmarium tinctum Ralfs, Brit. Desm. 1848, p. 95, t. 32, f. 7; Arch. in Pritch. Infus. 1861, p. 731; Kirchn. Alg. Schles. 1878, p. 148; Wolle, Desm. U.S., 1884, p. 61, t. 16, f. 31; Cooke, Brit. Desm. 1886, p. 90, t. 37, f. 7; Hansg. Prodr. Algenfl. Böhm. 1888, p. 248; De Toni, Syll. Alg. 1889, p. 942; West, Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 146; Alg. Eng. Lake Distr. 1892, p. 725; Roy & Biss. Scott. Desm. 1894, p. 176; Nordst. Index Desm. 1896, p. 255; West & G. S. West, Alg. S. England, 1897, p. 486; Alga-fl. Yorks. 1900, p. 73; Alg. N. Ireland, 1902, p. 34.
Sphærozosma tinctum Rabenh. Flor. Europ. Alg. III, 1868, p. 150.
Ursinella tincta Kuntze, Revis. gen. plant. 1891, p. 925.

Cells minute, a little longer than broad, moderately constricted, sinus narrow towards the apex but open outwards; semicells elliptic. Side view of semicell subcircular. Vertical view elliptic, ratio of axes about 1 : 1·8. Cell-wall smooth and of a reddish-brown colour. Chloroplasts axile, with one pyrenoid.

Zygospore subquadrate, with rounded angles and retuse sides; cell-wall smooth.

Length 10–15 μ; breadth 7·5–11·6 μ; breadth of isthmus 4·5–8·4 μ; thickness 5–9 μ; diam. zygosp. 11–15 μ.

England.—Cumberland! Westmoreland! W., N., and E. Yorks! Cheshire (*Roy*). Essex! Warwick (*Wills*). Surrey! Sussex (*Ralfs*). Kent! Hants! Devon! Cornwall! (*Ralfs*).

Wales.—Fairly general in Carnarvonshire!

Scotland.—General! Zygospores from Aberdeen and Kincardine (*Roy & Bissett*). Outer Hebrides! Shetlands!

Ireland.—Donegal! Mayo! Galway (zygospores from near Roundstone)! Kerry! Dublin and Wicklow! (*Archer*). Armagh!

Geogr. Distribution.—France. Belgium. Germany. Austria and Galicia. Hungary. Italy. Portugal. Norway. Sweden. Denmark. Bornholm. Finland. N. Russia. Faeroes. Greenland. Nova Zembla. New Zealand. Australia. E. Africa. Azores. United States. W. Indies. Brazil. Paraguay (var.). Patagonia.

C. tinctum is distinguished from both *C. bioculatum* and *C. tenue* by its proportionately longer cells which are not so deeply constricted. The semicells are more broadly elliptic, the sinus is more open, and the cell-wall is generally of a pale yellow or yellow-brown colour. The subquadrate form of the zygospore is also characteristic of the species.

It is a widely-distributed species and can sometimes be obtained in quantity in collections from boggy districts.

The cell-wall is not invariably tinted, colourless individuals being occasionally met with. Wille has described a form from Norway (*vide* 'Norges Ferskv. Alg.,' 1880, p. 36, t. 1, f. 22) in which the cell-wall is very delicately punctate, and Borge reports the occurrence of the same form in Greenland.

Nordstedt has described a trigonal form from New Zealand, in which the vertical view is triangular with rounded angles and slightly convex sides (*vide* 'Freshw. Alg. N. Zeal.,' 1888, p. 61, t. 3, f. 16).

Var. **intermedium** Nordst. (Pl. LXI, figs. 19, 20.)

C. tinctum Ralfs, var. *intermedium* Nordst. in Botan. Notis. 1887, p. 162; Freshw. Alg. N. Zeal. 1888, p. 61, t. 3, f. 17; De Toni, Syll. Alg. 1889, p. 943; Borge, Chlorophy. Norska Finmark. 1892, p. 13; West, Alg. Eng. Lake District, 1892, p. 725.

Semicells with the sinus not narrowed towards the apex; vertical view with a slight tumidity at the middle on each side; cell-wall often colourless.

Length 11–15 μ; breadth 10–12 μ; breadth of isthmus 6–8 μ; thickness 8–9 μ.

England.—Borrowdale, Cumberland!

Geogr. Distribution.—Norway. New Zealand.

This variety is intermediate in character between *C. tinctum* and *C. aspherosporum*.

27. **Cosmarium flavum** Roy & Biss.

(Pl. LXI, figs. 21, 22.)

Cosmarium flavum Roy & Biss. Scott. Desm. 1894, p. 101, t. 2, f. 17; Nordst. Index Desm. 1896, p. 124.

Cells rather small, about as long as broad, deeply constricted, sinus narrow towards the apex but opening outwards; semicells elliptic-oblong with a somewhat flattened apex. Side view of semicell subglobose. Vertical view elliptic, ratio of axes about 1 : 1·7. Cell-wall smooth and of a yellow colour.

Zygospore globose and smooth.

Length 32 μ; breadth 32 μ; breadth of isthmus 10 μ; thickness 15·5 μ; diam. zygosp. 40 μ.

Scotland. — Loch Inver, Sutherland; Scotston, Birsemore, Craigendinnie, Dinnet, Dawin, Auchnerran, and Glen Clunie, Aberdeen; Crathes, Cammie, and Dalbrake, Kincardine (*Roy & Bissett*).

We have not seen this species, which Roy & Bissett record as "rare" in Scotland. It appears to be very closely related to *Cosmarium contractum* forma *Jacobsenii* and *C. contractum* var. *ellipsoideum*, from each of which it chiefly differs in the cells being more flattened at the apices and in the yellow tint of the cell-wall.

28. **Cosmarium contractum** Kirchn.

(Pl. LXI, figs. 23–25, 34.)

Cosmarium contractum Kirchn. Alg. Schles. 1878, p. 147; Wolle, Desm. U.S. 1884, p. 63, t. 16, f. 1; t. 50, f. 24; De Toni, Syll. Alg. 1889, p. 949; West, Alg. N. Wales, 1890, p. 291; Alg. W. Ireland, 1892, p. 160; Alg. Eng. Lake Distr. 1892, p. 729; Roy & Biss. Scott. Desm. 1894, p. 44; West & G. S. West, Alg. Madag. 1895, p. 70, t. 8, f. 5; Nordst. Index Desm. 1896, p. 80; West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 175; Alg. S. England, 1897, p. 491; Freshw. Chlorophy. Koh Chang. 1901, p. 91; Alga-fl. Yorks. 1900, p. 74; Alg. N. Ireland, 1902, p. 40; Scott. Freshw. Plankton I, 1903, p. 526; Further Contrib. Freshw. Plankton Scott. Lochs, 1905, p. 483.

C. contractum a. *silesiacum* Racib. Nonn. Desm. Polon. 1885, p. 84.

Ursinella contracta Kuntze, Revis. gen. plant. 1891, p. 924.

Cells rather small, about $1\frac{1}{2}$ times longer than broad, very deeply constricted, sinus narrow towards the apex, rapidly widening outwards; semicells sub-elliptic,

ventral margin always more convex than the dorsal margin. Side view of semicell circular. Vertical view elliptic, ratio of axes 1 : 1·57. Cell-wall colourless and finely punctate. Chloroplasts axile, with one central pyrenoid.

Zygospore globose or angular-globose, smooth.

Length 34·5–41 μ; breadth 25–31 μ; breadth of isthmus 7–8·7 μ; thickness 18–19 μ; diam. zygosp. 31·5–35 μ.

England.—Bowness, Westmoreland! Widdale Fell, W. Yorks! Pilmoor, N. Yorks! Puttenham Common, Surrey!

Wales.—Llyn Bodgynwydd, Capel Curig, and Llyn-y-cwm-ffynon, Carnarvonshire!

Scotland.—Near Alford, and south of Birsemore, Aberdeen; Buchanty, Perth (*Roy & Bissett*). Rhiconich, Sutherland! Not uncommon in the plankton of Sutherland, Inverness, Ayrshire, and the Outer Hebrides!

Ireland.—Lough Gartan and near Lough Magrath, Donegal! Ballynahinch, Clifden, and Lough Aunierin, Galway! Cromagloun, Torc Mt., and Adrigole, Kerry! Lough Derryadd, Armagh!

Geogr. Distribution.—Germany. Galicia in Austria. Poland. Norway. India. Ceylon. Burmah. Siam. Australia. Central Africa. Madagascar. United States. Patagonia.

C. contractum is a somewhat rare British species, although it sometimes occurs in abundance in the plankton. It is very deeply constricted, the isthmus forming a narrow neck, and the sinus is widely open. The semicells in the front view are subelliptic in form, the lower margin being more convex than the upper one.

The Desmid described and figured by Turner ('Freshw. Alg. E. India,' 1893, p. 48, t. 7, f. 38, t. 9, f. 21) as *C. contractum* var. *punctatum* does not belong to this species.

Forma **Jacobsenii** (Roy) *nob.* (Pl. LXI, f. 26.)

Cosmarium moniliforme (Turp.) Ralfs forma *elliptica* Nordst. Norges. Desm. 1873, p. 22.

C. moniliforme Jacobs. Desm. Danem. 1876, p. 200, t. 8, f. 24.

C. Jacobsenii Roy in Biss. Desm. Windermere, 1884, p. 194; Cooke, Brit. Desm. 1887, p. 120, t. 43, f. 3; Nordst. Bornh. Desm. 1888, p. 200; Roy & Biss. Scott. Desm. 1894, p. 168.

Cells almost $1\frac{1}{2}$ times as long as broad, sinus open but rounded at the apex; semicells more equally elliptic or oblong-elliptic.

Length 28–45 μ; breadth 18–27 μ; breadth of isthmus 4·5–7·5 μ.

England.—Near Bowness, Westmoreland (*Bissett*).

Scotland.—Slewdrum, Presswhin, Logie-Coldstone, and Glen Clunie, Aberdeen; Crathes, and Dalbrake in Strachan, Kincardine (*Roy & Bissett*).

Geogr. Distribution.—Germany. Galicia in Austria. Norway. Sweden. Denmark. Bornholm. Central Africa.

This form is of the same relative length and breadth as typical *C. contractum*, but differs in the more regularly elliptic semicells. It is scarcely to be separated from it.

Var. **ellipsoideum** (Elfv.) West & G. S. West.

(Pl. LXI, figs. 28, 35.)

Cosmarium ellipsoideum Elfv. Anteck. Finska Desm. 1881, p. 13, t. 1, f. 10; De Toni, Syll. Alg. 1889, p. 953; West & G. S. West, Alg. S. England, 1897, p. 491.
Ursinella ellipsoidea Kuntze, Revis. gen. plant. 1891, p. 924.
Cosmarium contractum Kirchn. var. *ellipsoideum* (Elfv.) West & G. S. West, Alg. N. Ireland, 1902, p. 40.

Cells shorter, not more than $1\frac{1}{4}$ times as long as broad, semicells more exactly elliptic, although the apex is sometimes slightly flattened in the middle. Cell-wall usually smooth.

Zygospore globose and smooth.

Length 31–51 μ; breadth 24–42 μ; breadth of isthmus 7–12 μ; thickness 14·5–27 μ; diam. zygosp. 29–36 μ.

England.—Thursley Common, Surrey!

Wales.—Capel Curig, Carnarvonshire!

Scotland.—Skye, and also plankton of Loch Bairness, Inverness! Plankton of Lochs Langabhat, an Tomain, and Stranabhat, Lewis, and of Lochs

Diracleet and a Mhorghain, Harris, Outer Hebrides! Plankton of Loch Beosetter, Bressay, Shetlands!

Ireland.—Small lakes between Clifden and Roundstone, Galway!

Geogr. Distribution.—Germany. Sweden. Finland. N. Russia. Faeroes. Iceland. Australia.

We do not think that *C. ellipsoideum* Elfv. differs sufficiently from *C. contractum* Kirchn. to warrant its separation as a distinct species, and we have therefore placed it as a variety of that species. It differs from typical *C. contractum* in having relatively shorter cells, with a less widely-open sinus, and more exactly elliptical semicells. It is very variable in size, and there are three forms worthy of special mention:

(1) A form about half the normal size; length 22–23·5 μ; breadth 18–20 μ; breadth of isthmus 6·5–7·6 μ; thickness 11–12 μ. (Pl. LXI, figs. 30–32.) Not uncommon in the Scottish plankton. This form is probably identical with *C. minutum* Delp. ('Desm. subalp.' 1877, p. 105 (sep.), t. 7, f. 37–39), and perhaps would be better placed as *C. contractum* var. *minutum* (Delp.).

(2) A form of very variable size, with the sinus more closed (= *C. ellipsoideum* Elfv. var. *minor* Racib. Nonn. Desm. Polon. 1885, p. 84, t. 10, f. 9; *C. proteiforme* Turn. Freshw. Alg. E. India, 1893, p. 64, t. 9, f. 26); length 16–42 μ; breadth 11–29 μ; breadth of isthmus 4–8 μ; thickness 8–16 μ. (Pl. LXI, fig. 33). This form we have observed from Thursley Common, Surrey.

(3) A form in which the cells are slightly retuse in the middle of each apex; cell-wall delicately punctate; length 32 μ; breadth 27·5 μ; breadth of isthmus 5·5 μ (Pl. LXI, fig. 29). This form we described and figured in 'Alg. N. Ireland,' 1902, p. 40, t. 2. f. 10. It might stand as "var. *ellipsoideum* forma *retusa*." It was found at Glenties and in Lough Anna, Donegal.

Var. **Gartanense** West & G. S. West. (Pl. LXI, fig. 27.)

C. contractum Kirchn. var. *Gartanense* West & G. S. West, Alg. N. Ireland, 1902, p. 41, t. 2, f. 9.

Cells larger and usually a little longer; semicells at the middle of the apex abruptly retuse-emarginate.

Length 68 μ; breadth 43–44 μ; breadth of isthmus 10 μ.

Ireland.—Lough Gartan, Donegal!

Var. **Cracoviense** Racib.

C. contractum Kirchn. e. *Cracoviense* Racib. Nonn. Desm. Polon. 1885, p. 84, t. 10, f. 10; Roy & Biss. Scott. Desm. 1894, p. 44.

Semicells obtrapezoid, sides divergent and almost straight, basal and upper angles rounded, apex slightly convex.

Length 31–34 μ; breadth 22–26 μ; breadth of isthmus 8–9 μ; thickness 16·5–19 μ.

Scotland.—Dinnet, Aberdeen (*Roy & Bissett*).

29. **Cosmarium subcontractum** West & G. S. West.

(Pl. LXI, figs. 36, 37.)

Cosmarium subcontractum West and G. S. West, Further Contrib. Freshw. Plankton Scott. Lochs, 1905, p. 484 [name only]; Freshw. Alg. Orkneys and Shetlands, 1905, p. 20, t. 1, f. 21.

Cells small, a little longer than broad, very deeply constricted, sinus narrow near the apex but widely open outwards; semicells obversely semicircular, with a broad and almost straight apex, upper lateral angles rounded; side view of semicell circular. Vertical view elliptic, ratio of axes about 1 : 1·7. Cell-wall minutely punctate. Chloroplasts axile with one central pyrenoid.

Zygospore unknown.

Length 32·5–34 μ; breadth 30–31·5 μ; breadth of isthmus 7–8·5 μ; thickness 15–15·5 μ.

Scotland.—Bressay, Shetlands!

This species stands nearest to *C. contractum* Kirchn., but is distinguished by its broad, truncate apex. This feature causes the cells to be proportionately shorter.

30. **Cosmarium subaversum** Borge.

(Pl. LXI, fig. 38.)

Cosmarium subaversum Borge, Algologiska Notiser, 1897, p. 211, t. 3, f. 1.

Cells small, about $1\frac{1}{3}$ times longer than broad, moderately constricted, sinus open and subrectangular; semicells obsemicircular, upper angles well rounded,

apex slightly convex. Side view of semicell subcircular. Vertical view broadly elliptic, ratio of axes about 1 : 1·2. Cell-wall smooth.

Zygospore unknown.

Length 24·5–26 μ; breadth 18–19·5 μ; breadth of isthmus 9 μ.

Scotland.—Mull in Argyll ; in plankton (*Borge*).

C. subaversum Borge should be compared with *C. aversum* West & G. S. West, a species described from Madagascar. It is distinguished from that species by its much broader isthmus, by the more convex apices of the semicells, and by the elliptical vertical view. The cell-wall also is smooth, whereas that of *C. aversum* is irregularly punctate.

31. **Cosmarium tetrachondrum** Lund.

(Pl. LXII, fig. 1.)

Cosmarium tetrachondrum Lund. Desm. Suec. 1871, p. 38, t. 3, f. 2 ; Nordst. Norges Desm. 1873, p. 17 ; Jacobs. Desm. Danem. 1876, p. 195 ; Cooke, Brit. Desm. 1886, p. 89, t. 37, f. 5 ; De Toni, Syll. Alg. 1889, p. 956 ; Roy & Biss. Scott. Desm. 1894, p. 176 ; Nordst. Index Desm. 1896, p. 253 ; West and G. S. West, Alg. N. Ireland, 1902, p. 33.
Ursinella trachondra Kuntze, Revis. gen. plant. 1891, p. 925.

Cells small, about $1\frac{1}{3}$ times as broad as long, very deeply constricted, sinus very narrow and linear ; semicells transversely semi-elliptic (or very depressed-subsemicircular), basal angles rounded, apex truncate-convex, with a granule just above and near the extremity of each linear sinus. Side view of semicell circular with a basal granule on each side. Vertical view elliptic, ratio of axes about 1 : 2·25, with two granules on each side rather far apart. Cell-wall smooth. Chloroplasts axile, with only one pyrenoid.

Zygospore globose and smooth, sometimes showing a tendency to elongate irregularly.

Length 20·5 μ; breadth 23–26·3 μ; breadth of isthmus 6–7 μ; thickness 10·7 μ.

England.—Near Chapel Wood, S.E. Surrey !

Scotland.—Ross, Banff, Aberdeen, Kincardine, Forfar, and Perth; near Kingshouse, Argyll; zygospores from Deeside, Aberdeen (*Roy & Bissett*).

Ireland.—Lough Gartan, Donegal! Tipperary (*Archer*).

Geogr. Distribution.—Galicia in Austria. Poland. S. Russia. Norway. Sweden. Denmark.

32. **Cosmarium depressum** (Näg.) Lund.

(Pl. LXII, figs. 2–5.)

Euastrum (*Tetracanthium*) *depressum* Näg. Gatt. Einzell. Alg. 1849, p. 114, t. 7 C, f. 2.

Cosmarium depressum (Näg.) Lund. Desm. Suec. 1871, p. 38; Kirchn. Alg. Schles. 1878, p. 148; Wolle Desm. U. S. 1884, p. 64, t. 50, f. 10–12; Hansg. Prodr. Algenfl. Böhm. 1888, p. 195; De Toni, Syll. Alg. 1889, p. 940; Roy & Biss. Scott. Desm. 1894, p. 45; Nordst. Index Desm. 1896, p. 101; West & G. S. West, Freshw. Alg. Orkneys and Shetlands, 1905, p. 20.

Staurastrum convergens (Ehrenb.) Menegh. *β inermis* Jacobs. Desm. Danem. 1876, p. 203.

Cosmarium Scenedesmus Delp. Desm. subalp. 1877, p. 5, t. 7, f. 28–34; Wolle, Desm. U. S. 1884, p. 59, t. 50, f. 7–9; De Toni, Syll. Alg. 1889, p. 956; West, Alg. N. Wales, 1890, p. 288; Add. Alg. W. Yorks. 1891, p. 246; Alg. W. Ireland, 1892, p. 145; Alg. Eng. Lake Distr. 1892, p. 725; Nordst. Index Desm. 1896, p. 229; West & G. S. West, Alg. S. England, 1897, p. 486; Alga-fl. Yorks. 1900, p. 73; Alg. N. Ireland, 1902, p. 33; Scott. Freshw. Plankton, I, 1903, p. 526.

Ursinella depressa Kuntze, Revis. gen. plant. 1891, p. 924.

U. Scenedesmus Kuntze, l. c. p. 925.

Cosmarium Scenedesmus Delp. forma *punctata* West, Alg. W. Ireland, 1892, p. 145; Turner, Freshw. Alg. E. India, 1893, p. 60, t. 8, f. 61 [“*β punctatum*”].

Cells rather small, a little broader than long, deeply constricted, sinus narrowly linear, opening outwards; semicells depressed, transversely subelliptic, apex convex-truncate, sides of semicells rounded. Side view of semicell circular. Vertical view elliptic, ratio of axes about 1 : 2·2. Cell-wall finely punctulate. Chloroplasts axile, each with one pyrenoid.

Zygospore globose or ellipsoid, smooth.

Length 37–43 μ; breadth 40–50 μ; breadth of isthmus 12–14 μ; thickness 17·5–20 μ; diam. zygosp. about 35 μ.

England.—Malham Tarn, W. Yorks! Skipwith Common, E. Yorks! Epping Forest, Essex! Thursley Common, Surrey!

Wales.—Capel Curig, Llyn Idwal, and Llyn Ogwen, Carnarvonshire!

Scotland.—Sutherland!, Ross, Inverness!, Aberdeen, Perth! (*Roy & Bissett*). Lewis and Harris, Outer Hebrides! Orkneys! Shetlands! Not uncommon in the plankton!

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Londonderry!

Geogr. Distribution.—Germany. Galicia in Austria. Italy. Faeroes. Greenland. India. Ceylon. Burmah. New Zealand (var.). Australia. Abyssinia. United States.

There appears to be no doubt of the almost strict identity of "*Euastrum depressum* Näg." (1849) and "*Cosmarium Scenedesmus* Delp." (1877). Lundell first pointed out the affinities of this Desmid, and also placed it under the genus *Cosmarium* as *C. depressum* Näg. (Lund.).

C. depressum is distinguished from *C. Phaseolus* by its proportionately greater breadth, by its depressed-elliptic semicells (not reniform), and by the absence of a central protuberance. It also bears a great resemblance to *Arthrodesmus convergens* Ehrenb. without the spines, and Jacobsen actually referred it to this species as "var. *inermis*."

Var. **achondrum** (Boldt) West & G. S. West. (Pl. LXII, figs. 6–9.)

C. Phaseolus Bréb. var. *achondrum* Boldt, Sibir. Chlorophy. 1885, p. 103, t. 5, f. 7; De Toni, Syll. Alg. 1889, p. 1002; Schmidle, Beitr. Algenfl. Schwarzwald. u. Rheineb. 1893, p. 102, t. 5, f. 11; Börg. Freshw. Alg. Östgrönl. 1894, p. 19, t. 1, f. 13; Roy & Biss. Scott. Desm. 1894, p. 171.
C. depressum (Näg.) Lund. var. *achondrum* (Boldt) West & G. S. West, Further Contrib. Freshw. Plankton Scott. Lochs, 1905, p. 484.

Cells as long as broad, or nearly so; semicells subhexagonal-elliptic, apex broader and more truncate.

Length 37–51 μ; breadth 40–51 μ; breadth of isthmus 12–17 μ; thickness 22–23 μ.

England.—Malham Tarn, W. Yorks!

Wales.—Capel Curig Lakes, Carnarvonshire!

Scotland.—Near Loch Coruisk in Skye, Inverness (*Roy & Bissett*). Mull in Argyll (*Borge*). General in the plankton of the mainland and the Outer Hebrides!

Ireland.—Lough Gartan, Donegal! Lakes between Clifden and Roundstone, Galway!

Geogr. Distribution.—Germany. Galicia in Austria. Norway. Sweden. Bornholm. Finland. Faeroes. Iceland. Spitzbergen. Uruguay.

There are two very strong reasons for referring this variety to *C. depressum* (Näg.) Lund. rather than to *C. Phaseolus* Bréb. In the first place, there is an entire absence of the central protuberance which is a characteristic feature of *all forms* of *C. Phaseolus*; secondly, it is associated in large numbers with numerous specimens of *C. depressum* in the plankton of many of the lakes of the British Islands. Numerous intermediate forms occur in the plankton which clearly connect it with the more rounded typical forms of *C. depressum*. It is very variable in size and also in the width of its isthmus.

Var. **reniforme** *var. nov.* (Pl. LXII, fig. 10.)

Cells rather small; semicells narrowly reniform, sinus slightly open.

Length 21 μ; breadth 26 μ; breadth of isthmus 6·5 μ.

England.—Helvellyn, Westmoreland!

This variety differs from *C. subdepressum* West & G. S. West in the open sinus, the smooth cell-wall, and the presence of only one pyrenoid in each semicell.

33. **Cosmarium subquadrans** *sp. nov.*

(Pl. LXII, figs. 11–13.)

Cells small, a little broader than long, oblong-quadrate, very deeply constricted, sinus very narrowly linear, slightly dilated at the extremity; semicells transversely oblong, basal angles obtuse, sides almost parallel in the lower half, upper half well rounded to form the upper angles, apex broad and truncate (slightly convex). Side view of semicell circular. Vertical view fusiform elliptic, ratio of axes about 1 : 2·14. Cell-wall smooth. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 21·5–25 μ; breadth 26·5–30 μ; breadth of isthmus 6·5–8·7 μ; thickness 14 μ.

England.—Near Bowness, Westmoreland!

Ireland.—Small lakes between Clifden and Roundstone, Galway!

This species comes near to *C. quadrans* Turn., but differs in being less quadrate, in its proportionately greater breadth, in the more rounded upper angles of the semicells, and consequently in the much shorter sides. The cell-wall also is smooth.

It should also be compared with *C. subdepressum* West & G. S. West ('Some N. Amer. Desm.' 1896, p. 247, t. 15, f. 15), from which it is distinguished by the angular form of its semicells, by the stouter vertical view, and by the smooth cell-wall.

34. **Cosmarium succisum** West.

(Pl. LXII, figs. 14–16.)

Cosmarium succisum West, Alg. W. Ireland, 1892, p. 146, t. 20, f. 22, 23; Nordst. Index Desm. 1896, p. 248; West & G. S. West, Alg. S. England, 1897, p. 486; Alga-fl. Yorks. 1900, p. 91.

C. tinctum Ralfs var. *succisum* West & G. S. West, Alg. N. Ireland, 1902, p. 34.

Cells minute, about as long as broad, moderately constricted, sinus open, with a short, narrow extremity; semicells trapeziform-elliptic, angles rounded, sides slightly retuse, apex broadly truncate (or very slightly concave). Side view of semicell circular. Vertical view elliptic, very slightly subtumid at the middle on each side. Cell-wall smooth and of a yellow or reddish-brown colour. Chloroplasts axile with one pyrenoid.

Zygospore unknown.

Length 10–12·5 μ; breadth 11–12·5 μ; breadth of isthmus 3·75–5 μ; thickness 6 μ.

England.—Wigton Moor, W. Yorks! Riccall and Skipwith Commons, E. Yorks! Puttenham Common, Surrey!

Wales.—Capel Curig, Carnarvonshire!

Ireland.—Near Glenties and Lough Anna, Donegal! Creggan and Derryclare Loughs, and Clifden, Galway!

Lough Deryadd, Armagh! Slieve Donard and Slieve Bearnagh, Down!

This species is distinguished at once from *C. tinctum* Ralfs by the form of its semicells both in the front and the vertical view.

It differs from *C. abbreviatum* Racib. in its smaller size, its different sinus, its relatively greater length, in the form of its semicells, the slight central protuberance of the vertical view, and the colour of its cell-wall. From *C. pseudobiremum* Boldt, it is distinguished by the form of its semicells, having the apex more truncate, by the less tumid vertical view, by its smaller size, and by the reddish-brown cell-wall.

35. **Cosmarium subretusiforme** West & G. S. West. (Pl. LXII, fig. 19.)

Cosmarium subretusiforme West & G. S. West, New Brit. Freshw. Alg. 1894, p. 5, t. 1, f. 20; Nordst. Index Desm. 1896, p. 247.

Cells very minute, $1\frac{1}{4}$ times longer than broad, moderately constricted, sinus open and obtuse; semicells subrectangular, basal angles broadly rounded, upper part of sides retuse, upper angles acute, apex broadly truncate and straight. Side view of semicell elliptic-subcircular. Vertical view elliptic with subacute poles, ratio of axes about 1 : 2·2. Cell-wall smooth.

Zygospore unknown.

Length 7·8–8 μ; breadth 6·2–6·5 μ; breadth of apex 5·5 μ; breadth of isthmus 4·5 μ; thickness 3 μ.

England.—Borrowdale, Cumberland!

This minute species approaches *Cosmarium retusiforme* (Wille) Gutw. in its front view, but is distinguished by its much smaller size, its broader apices, and its different side and vertical views.

36. **Cosmarium retusiforme** (Wille) Gutw. (Pl. LXII, figs. 17, 18.)

Cosmarium Hammeri Reinsch var. *retusiforme* Wille, Norges Ferskv. Alg. 1880, p. 32, t. 1, f. 16.

C. retusiforme (Wille) Gutw. Wahr. d. Priorität, 1890, p. 69; Flor. Glon. Okolic Lwowa, 1891, p. 55, t. 2, f. 12.

Cells small, a little longer than broad, deeply constricted, sinus narrow, opening outwards; semicells truncate-subpyramidate, lower half of sides rounded, upper half markedly retuse, apex widely truncate and straight, upper angles sharp and rectangular. Side view of semicell ovate, upper part of sides retuse. Vertical view elliptic, inflated at the middle on each side. Cell-wall smooth. Chloroplasts axile, with one pyrenoid.

Zygospore unknown.

Length 22·5–24 μ; breadth 19–19·5 μ; breadth of isthmus 6–7 μ; breadth of apex 9–12 μ; thickness 12–13 μ.

Ireland.—Ballynahinch, Galway!

Geogr. Distribution.—Austria (var.) and Galicia. Poland. Central Africa. United States. Brazil (var.).

This species bears some resemblance to *C. retusum* (Perty) Rabenh., but the latter is larger, more deeply constricted, with a more produced apical part of the semicells, which is not so wide, and is also sparsely furnished with granules. *C. retusiforme* differs from *C. Hammeri* in its more open sinus, its abruptly-truncate apex, its sharp superior angles, and in its smaller size.

37. **Cosmarium Hammeri** Reinsch.

(Pl. LXII, figs. 20, 21.)

Cosmarium Hammeri Reinsch, Spec. Gen. Alg. 1867, p. 115, t. 22 B, I, f. 1–10 [inclusive of A. *majus* and B. *intermedium*]; Lund. Desm. Suec. 1871, p. 37; Wolle, Desm. U. S. 1884, p. 79, t. 18, f. 27; Cooke, Brit. Desm. 1886, p. 81; Hansgirg, Prodr. Algenfl. Böhm. 1888, p. 194; De Toni, Syll. Alg. 1889, p. 936; West, Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 142; Alg. Eng. Lake Distr. 1892, p. 724; Roy & Biss. Scott. Desm. 1894, p. 103; West & G. S. West, Some N. Amer. Desm. 1896, p. 245; Nordst. Index Desm. 1896, p. 137; West & G. S. West, Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 74; Alg. N. Ireland, 1902, p. 32.

Didymidium (*Cosmarium*) *Hammeri* A. *majus* Reinsch, Algenfl. Frank. 1867, p. 111, t. 10, f. 1.

Euastrum Hammeri Cohn, Desm. Bong. 1879, p. 270.

Ursinella Hammeri Kuntze, Revis. gen. plant. 1891, p. 924.

Cells of moderate size, about $1\frac{1}{4}$ times longer than broad, subhexagonal, deeply constricted, sinus narrowly linear with a dilated apex, opening outwards; semicells truncate-pyramidate, basal angles well rounded,

upper part of sides suddenly converging and slightly retuse, upper angles rounded, apex broadly truncate, straight or slightly retuse. Side view of semicell elliptic-ovate. Vertical view elliptic, ratio of axes about 1 : 1·8. Cell-wall smooth. Chloroplasts axile with one pyrenoid.

Zygospore unknown.

Length 40–50 μ; breadth 27–35 μ; breadth of isthmus 11–13 μ;

England.—Westmoreland! (*Bissett*). W. Yorks.

Wales.—Near Bodorgan, Anglesey!

Scotland.—Near Rhiconich, Sutherland!

Ireland.—Galway! Dublin and Wicklow (*Archer.*)

Geogr. Distribution.—France. Germany. Galicia in Austria. Hungary. Italy. Portugal. Norway. Sweden. Denmark. N. and S. Russia. Finland. Siberia. Greenland. Central China. Japan. India. Ceylon. Burmah. Sumatra (form). New Zealand (var.). Australia. Central and E. Africa. United States. Brazil. Paraguay. Patagonia.

Despite its world-wide distribution the form of *C. Hammeri* described by Reinsch as "A. *majus*" is a very rare British Desmid. This form we regard as the type of the species, and it possesses an elliptical vertical view with no trace of a median inflation.

Var. **homalodermum** (Nordst.) *nob.* (Pl. LXII, figs. 22, 23.)

Cosmarium pyramidatum Bréb. forma *intermedia* Nordst. Norges Desm. 1873, p. 19.

Cosmarium homalodermum Nordst. Desm. Arctoæ, 1875, p. 18, t. 6, f. 4; Desm. Ital. 1876, p. 34; Wolle, Desm. U. S. 1884, p. 81, t. 17, f. 19, 20; Cooke, Brit. Desm. 1886, p. 82, t. 36, f. 7; De Toni, Syll. Algar. 1889, p. 1043; West, Alg. N. Yorks. 1889, p. 292; Alg. N. Wales, 1890, p. 288; Roy & Biss. Scott. Desm. 1894, p. 104; Nordst. Index Desm. 1896, p. 141.

C. homalodermum Nordst. var. *rotundatum* Wille, Ferskv. Alg. Nov. Semlja, 1879, p. 36, t. 12, f. 18.

Ursinella homaloderma Kuntze, Revis. gen. plant. 1891, p. 924.

Cells rather larger, sometimes shorter; vertical view slightly tumid at the middle on each side; side view of semicell more ovate (sometimes subspherical); cell-wall thicker, very finely and often indistinctly punctate.

Length 54–66 μ : breadth 48–51 μ ; breadth of apex about 19–20 μ ; breadth of isthmus 18–19 μ ; thickness 29–34 μ.

England.—Westmoreland! W., N., and E. Yorks! Devon (*Bennett*). Cornwall! (*Marquand*).

Wales.—Moel Siabod, Snowdon, and Yr Orsedd, Carnarvonshire! Dolgelly, Merioneth!

Scotland.—Ross, Inverness, Aberdeen, Kincardine, Forfar!, Perth, Stirling, Argyll (*Roy & Bissett*). Sutherland! Orkneys!

Ireland.—Donegal! Galway! Kerry!

Geogr. Distribution.—Germany. Norway. Sweden. Greenland. Spitzbergen. Nova Zembla. N. Russia. Faeroes. India.

This variety differs principally from *C. Hammeri* in its larger size and in the tumid vertical view. It is, however, very variable, especially with regard to the sides of the semicells and the apex. The latter may be slightly retuse, straight, or convex, and the apices of the semicells of one individual may differ considerably.

In Britain it is found mostly in subalpine localities, especially in mountain springs and in the vicinity of dripping rocks.

We have included in this variety "*C. homalodermum* var. *rotundatum* Wille" as the side view of the semicell is somewhat variable. Intermediate stages can be met with between a subcircular and an ovate side view. Börgesen also finds this Desmid to be very variable in the Faeroes, and to reach a length of 70 μ and a breadth of 58 μ (*vide* 'Freshw. Alg. Faeroes,' 1901, p. 222).

Var. **protuberans** West & G. S. West. (Pl. LXII, figs. 24, 25.)

C. Hammeri Reinsch. var. "with inflated sides" Wolle, Desm. U.S. 1884, t. 18, f. 36-38.

C. Hammeri Reinsch var. *protuberans* West and G. S. West, Some N. Amer. Desm. 1896, p. 246, t. 14, f. 35.

Cells rather small; vertical view with a median tumour on each side.

Zygospore globose, furnished with numerous, simple spines, which are dilated at the base.

Length 24–35 μ; breadth 18·5–21·5 μ; breadth of isthmus 7–7·5 μ; thickness 11–12·5 μ; diam. zygosp. without spines 30 μ, with spines 46 μ.

Scotland.—Harris, Outer Hebrides!

Geogr. Distribution.—United States.

In the zygospore we examined (from the United States) the apices of the spines were simple, but Wolle has figured a zygospore in which the spines are furcate.

Var. **Hibernicum** Cooke.

C. Hammeri forma, Crowe in Quart. Journ. Micr. Sci. 1873, p. 435.
C. Hammeri var. *Hibernicum* Cooke, Brit. Desm. 1886, p. 81.

Cells about $1\frac{1}{3}$ times longer than broad, apices convex-truncate; in the side view with a minute tooth-like protuberance visible at the constriction.

Ireland.—Arklow, Co. Wicklow (*Crowe*).

38. **Cosmarium Nymannianum** Grun.

(Pl. LXII, figs. 26, 27.)

Cosmarium Nymannianum Grun. in Rabenh. Flor. Europ. Alg. III, 1868, p. 166; Lund Desm. Suec. 1871, p. 36, t. 3, f. 1; Wolle, Desm. U. S. 1884, p. 79; Cooke, Brit. Desm. 1886, p. 82, t. 36, f. 1; De Toni, Syll. Alg. 1889, p. 964; West, Alg. W. Ireland, 1892, p. 142; Alg. Eng. Lake Distr. 1892, p. 724; Roy & Biss. Scott. Desm. 1894, p. 169; Nordst. Index Desm. 1896, p. 184; West & G. S. West, Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 78; Alg. N. Ireland, 1902, p. 32; Freshw. Alg. Ceylon, 1902, p. 161.
Ursinella Nymanniana Kuntze, Revis. gen. plant. 1891, p. 925.

Cells rather small, elongate-subhexagonal, about $1\frac{1}{3}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells truncate-pyramidate, basal angles rounded, lower half of sides convex, upper half concave, upper angles rounded, apex retuse, in the centre with a large and conspicuous scrobiculation. Side view of semicell subcircular. Vertical view subrhomboid-elliptic, at the middle on each side thickened and showing the large scrobiculation, ratio of axes about 1 : 1·8. Cell-wall distinctly punctate. Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 44–48 μ; breadth 33–36·5 μ; breadth of apex 21 μ; breadth of isthmus 7·6–9·6 μ; thickness 20–22 μ.

England.—Elter Water, Westmoreland! (*Bissett*). Keighley Tarn, W. Yorks! Great Shunnor Fell, N. Yorks! Thursley Common, Surrey! Hants (*Joshua*). Cornwall (*Joshua*).

Wales.—Moel Siabod!, Capel Curig (*Cooke & Wills*), and Llyn Teyrn on Snowdon!, Carnarvonshire.

Scotland.—Sutherland!, Ross, Inverness, Aberdeen, Kincardine, Forfar, Perth, Argyll, Arran (*Roy & Bissett*). Orkneys!

Ireland.—Near Loughs Magrath and Glentornan, Donegal! Oorid Lough and Ballynahinch, Galway! Glen Caragh, Castletown, and Lower Lake of Killarney, Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—France. Germany. Galicia in Austria. Norway. Sweden. Denmark. Poland. S. Russia. Faeroes. Ceylon. United States.

C. Nymannianum bears considerable resemblance to *C. Hammeri*, but can be distinguished by its punctate cell-wall and by the large scrobiculation in the centre of the semi-cells.

Joshua reports the zygospores of this species from Alton, Hants, and from Cornwall, but neither describes nor figures them (*vide* Joshua, 'Notes Brit. Desm. II,' 1883).

39. **Cosmarium trilobulatum** Reinsch.

(Pl. LXII, figs. 28–30.)

Cosmarium trilobulatum Reinsch, Spec. Gen. Alg. 1867, p. 118, t. 22 A II, f. 1-6; Lund. Desm. Suec. 1871, p. 42; De Toni, Syll. Alg. 1889, p. 960; West, Alg. W. Ireland, 1892, p. 143; Alg. Eng. Lake Distr. 1892, p. 724; Roy & Biss. Scott. Desm. 1894, p. 176; Nordst. Index Desm. 1896, p. 250; West & G. S. West, Alg. S. England, 1897, p. 485.

Didymidium (*Cosmarium*) *trilobulatum* Reinsch, Algenfl. Franken, 1867, p. 116, t. 9, f. 6.

Ursinella trilobulata Kuntze, Revis. gen. plant. 1891, p. 925.

Cells very small, a little longer than broad up to almost 1½ times longer than broad, deeply constricted, sinus narrowly linear with a slightly-dilated extremity;

semicells somewhat three-lobed, lobes short, subrectangular with rounded angles, apical lobe widest, apex straight or slightly convex, incisions between lobes wide and shallow. Side view of semicell broadly subelliptic. Vertical view elliptic, ratio of axes about 1 : 2. Cell-wall smooth. Chloroplasts axile with one pyrenoid.

Zygospore unknown.

Length 20–23 μ; breadth 13–20 μ; breadth of isthmus 3·8–4·4 μ; thickness 6–7·5 μ.

England.—Bowness, Westmoreland! New Forest, Hants!

Scotland.—Corbie Loch north, and Springhill west of Aberdeen; Loch of Lumgair near Stonehaven, Kincardine; Buchanty in Fowlis Wester, Perth (*Roy & Bissett*). Hoy, Orkneys! Near Scalloway, Shetlands!

Ireland.—Cloonee Lough, Kerry!

Geogr. Distribution.—France. Germany. Hungary. N. Russia. Poland. Norway. Sweden. New Zealand. Madagascar. Central and E. Africa. Brazil.

This species should be compared with *C. Pokornyanum*.

40. **Cosmarium granatum** Bréb.

(Pl. LXIII, figs. 1–3.)

Cosmarium granatum Bréb. in Ralfs' Brit. Desm. 1848, p. 96, t. 32, f. 6; Bréb. Liste Desm. 1856, p. 126; Arch. in Pritch. Infus. 1861, p. 732; Rabenh. Flor. Europ. Alg. III, 1868, p. 162; Nordst. Desm. Arctoæ, 1875, p. 19; Kirchn. Alg. Schles. 1878, p. 147; Wolle, Desm. U. S. 1884, p. 60, t. 50, f. 13; Cooke, Brit. Desm. 1886, p. 83, t. 36, f. 9; Hansg. Prodr. Algenfl. Böhm. 1888, p. 192; Boldt, Desmid Grönland, 1888, p. 12; Nordst. Bornh. Desm. 1888, p. 198; Freshw. Alg. N. Zeal. 1888, p. 56; De Toni, Syll. Alg. 1889, p. 931; West, Alg. N. Wales, 1890, p. 288; Heimerl, Desm. alpin. 1891, p. 596; Borge, Bidr. Siber. Chlor. 1891, p. 12; Chlor. Norska Finmark. 1892, p. 12; West. Alg. W. Ireland, 1892, p. 143; Alg. Eng. Lake Distr. p. 724; Roy & Biss. Scott. Desm. 1894, p. 102; West & G. S. West, Alg. Madag. 1895, p. 54; Nordst. Index Desm. 1896, p. 133; West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 113; Alg. S. England, 1897, p. 485; G. S. West, Alga-fl. Cambr. 1899, p. 115; West & G. S. West, Alga-fl. Yorks. 1900, p. 78; Alg. N. Ireland, 1902, p. 32; Freshw. Alg. Ceylon, 1902, p. 162; Scott. Freshw. Plankton, I, 1903, p. 526; Further Contrib. Freshw. Plankton Scott. Lochs, 1905, p. 484.

Didymidium (*Cosmarium*) *granatum* Reinsch, Algenfl. Frank, 1867, p. 109.

Cosmarium granatum Bréb. a. *typicum* Klebs, Desm. Ostpreuss, 1879, p. 32.

Euastrum (*Cosmarium*) *granatum* Gay, Monogr. loc. Conj. 1884, p. 59.

Cosmarium granatum Bréb. var. *concavum* Lagerh. Contrib. alg. Ecuad. 1890, p. 282.
Ursinella granata Kuntze, Revis. gen. plant. 1891, p. 924.

Cells small, about $1\frac{1}{2}$ times as long as broad, subrhomboid-elliptic, deeply constricted, sinus narrowly linear, slightly dilated at the apex; semicells truncate-pyramidate, basal angles rounded-subrectangular, sides at the base subparallel, then converging towards the apex, commonly straight or slightly convex (rarely slightly concave), upper angles obtuse, apex narrowly truncate and straight. Side view of semicell elliptic-ovate. Vertical view elliptic, ratio of axes about 1 : 1·6. Cell-wall finely punctate. Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 26–47 μ; breadth 19–30 μ; breadth of isthmus 6–9 μ; thickness 10·5–17·5 μ.

England.—Cumberland! Westmoreland! (*Bissett*). W., N., and E. Yorks! Lancashire! Lincolnshire! Essex! Cambridgeshire! Gloucester! (*Cooke*). Surrey! Kent! Hants! Devon! Cornwall! (*Ralfs*).

Wales.—Capel Curig! (*Cooke & Wills*), Bethesda!, and Llyn Padarn!, Carnarvonshire. Dolgelly, Merioneth (*Ralfs*).

Scotland.—General! (*Roy & Bissett*). Not uncommon in the plankton! Orkneys! Shetlands!

Ireland.—General!

Geogr. Distribution.—France. Germany. Austria and Galicia. Poland. Hungary. Italy. Bosnia. Portugal. Norway. Sweden. Denmark. Bornholm. Finland. N. and S. Russia. Siberia. Faeroes. Iceland. Greenland. Spitzbergen. Nova Zembla. Afghanistan. Kordofan. India. Ceylon. Burmah. Central China. New Zealand. Australia. W., Central, and E. Africa. Madagascar. United States. West Indies. Ecuador (var.). Brazil. Paraguay (var.). Argentina. Patagonia.

C. granatum Bréb. is one of the most widely distributed of all Desmids, being found in every part of the globe which

has been botanically investigated. As would be expected from its cosmopolitan distribution, it exhibits a considerable amount of variation, and some fifteen named varieties have been described by different authors.

In its most typical form the basal angles of the semicells are rectangular, and the upper portions of the sides are straight and rapidly converging to a somewhat narrow, subtruncate apex. The sides are, however, frequently concave in their upper portions, this form having been named "var. *concavum*" by Lagerheim. As there is every intermediate condition we do not think the forms with the concave sides constitute a variety worthy of a special name.

Another form, which is sometimes met with abundantly, possesses slightly inflated semicells, so that the sides are distinctly convex and the apex is not so evidently subtruncate. This form has been figured by Gutwinski ('Nagj. dosel. Bosni Hercegovin. halugam.' 1896, p. 374, t. 1, f. 2 *a'*) and by Borge ('Subfoss. sötv. alg. Gotl.' 1892, t. 1, f. 4).

Var. **subgranatum** Nordst. (Pl. LXIII, figs. 5–8.)

C. granatum Bréb. var. *subgranatum* Nordst. Alg. aq. dulc. et Char. Sandvic. 1878, p. 13, t. 2, f. 8; De Toni, Syll. Alg. 1889, p. 932; West, Alg. W. Ireland, 1892, p. 143; in Naturalist, 1893, p. 213; Johns. Rare Desm. U.S. II, 1895, p. 293, t. 239, f. 16; Nordst. Index Desm. 1896, p. 135; West & G. S. West, Alga-fl. Yorks. 1900, p. 79; Alg. N. Ireland, 1902, p. 32.

Semicells near the base at first diverging for a short distance, then with the lateral margins converging and 1–2-undulate, apex very narrowly truncate; vertical view narrowly elliptic and slightly tumid at the middle on each side.

Zygospore globose, furnished with a few short simple spines, each spine arising from the apex of a depressed-conical projection.

Length 24–30 μ; breadth 17–22 μ; breadth of isthmus 6–9 μ; thickness 13–14 μ; diam. zygosp. without spines 25–29 μ, with spines 32–34·5 μ.

England.—Westmoreland! W., N., and E. Yorks! Lincolnshire! Essex! Cambridgeshire! Gloucester (with zygospores from near Cirencester)! Surrey! Devon! Cornwall!

Scotland.—Largs and Cumbrae, Ayrshire! Suther-

land! Inverness! Orkneys! Shetlands! Sometimes in the plankton!

Ireland.—Donegal! Mayo! Galway! Down! Louth! Tyrone!

Geogr. Distribution.—France. Galicia in Austria. Bosnia. Sweden. Sandwich Is. New Zealand. United States. Brazil. Paraguay. Argentina.

In the British Islands this variety is almost as generally distributed as the type.

Some small forms were observed from Cambridgeshire intermediate in character between *C. granatum* var. *subgranatum* and *C. granatoides* Schmidle ('Chlorophy.-Fl. Torfstiche Virnheim,' 1894, p. 52, t. 7, f. 12; *C. Meneghinii* var. *granatoides* Schmidle, 'Beitr. Algenfl. Schwarzwald. u. Rheineb.,' 1893, p. 28, t. 6, f. 15). Consult G. S. West, 'Alga-fl. Cambr.,' 1899, p. 115. It is most probable that "*C. granatoides*" is only one of the numerous varieties of *C. granatum*.

Var. **elongatum** Nordst. (Pl. LXIII, fig. 10.)

C. granatum Bréb. var. *elongatum* Nordst. Desm. Spetsb. 1872, p. 29, t. 6, f. 6; Desm. Ital. 1876, p. 32; Schaarschm. Afghan. Alg. 1884, p. 247; Boldt, Desmid. Grönland, 1888, p. 12; Roy & Biss. Scott. Desm. 1894, p. 102.

Cells twice as long as broad, less deeply constricted; semicells somewhat elongated on the basal part.

Length 48–59 μ; breadth 25·2–29 μ; breadth of isthmus 14 μ.

Scotland.—Near Aboyne, at Homehead in Logie-Coldstone, and in Ballochbuie near Balmoral, Aberdeen; Muchalls, Kincardine; Reeky Linn, Forfar (*Roy & Bissett*).

Geogr. Distribution. — Spitzbergen. Greenland. Afghanistan.

Schaarschmidt mentions the occurrence of zygospores of this variety in Afghanistan, but he neither describes nor figures them.

Var. **Grunowii** Roy & Biss. (Pl. LXIII, fig. 9.)

C. granatum Bréb. var. Grun. Diat. u. Desm. Ins. Bank. 1865, p. 15, t. 2, f. 27.

C. granatum Bréb. var. *Grunowii* Roy & Biss. Scott. Desm. 1894, p. 102.

Cells with a more open sinus; semicells with rounder basal angles, convex lateral margins, and relatively broad apices.

Length 28 μ; breadth 17–18 μ; breadth of isthmus 5·2–6·7 μ.

Scotland.—Break Neck Fall in Glen Callater, Aberdeen (*Roy & Bissett*).

Geogr. Distribution.—Island of Banka.

We have not seen this variety and cannot definitely state whether it is correctly placed under *Cosmarium granatum* or not. We give a copy of Grunow's figures, which are not very good.

41. **Cosmarium Pokornyanum** (Grun.) West & G. S. West.

(Pl. LXIII, figs. 11–15.)

Euastrum Pokornyanum Grun. in Rabenh. Flor. Europ. Alg. III, 1868, p. 185; De Toni, Syll. Alg. 1889, p. 1073; Hansg. Prodr. Algenfl. Böhm. 1892, II, p. 175.

E. binale (Turp.) Ehrenb. var. *angustatum* Wittr. Gotl. Öl. sötv. Alg. 1872, p. 50, t. 4, f. 8; Cooke, Brit. Desm. 1886, p. 75, t. 35, f. 9.

E. polare Nordst. Desm. Spetsb. 1872, p. 37, t. 7, f. 24.

Cosmarium angustatum (Wittr.) Nordst. Desm. Arctoæ, 1875, p. 20; Wille, Ferskv. Alg. Nov. Semlj. 1879, p. 39, t. 12, f. 36; Boldt, Desmid. Grönland, 1888, p. 12; De Toni, Syll. Alg. 1889, p. 1044; Heimerl, Desm. alpin. 1891, p. 599; West, Alg. W. Ireland, 1892, p. 143; Lütkem. Desm. Attersees, 1893, p. 550; Roy & Biss. Scott. Desm. 1894, p. 41; Nordst. Index Desm. 1896, p. 45; G. S. West, Alga-fl. Cambr. 1899, p. 217.

C. Pokornyanum (Grun.) West & G. S. West, Notes Alg. II, 1900, p. 292; Alga-fl. Yorks. 1900, p. 79; Alg. N. Ireland, 1902, p. 32.

Cells small, about twice as long as broad, or nearly so, deeply constricted, sinus narrow, generally linear with a slightly-dilated apex; semicells subtrilobed or truncate-pyramidate from a base with parallel sides, basal angles rectangular, lower part of sides parallel, generally slightly retuse (rarely straight), upper part of sides longer, converging and widely concave, apex truncate and slightly retuse, upper angles rounded. (In those forms which are subtrilobed the apical lobe is subquadrate.) Side view of semicell ovate-truncate. Vertical view rhomboid-elliptic, ratio of axes about

1 : 1·3. Cell-wall smooth. Chloroplasts axile, with one pyrenoid.

Zygospore unknown.

Length 23–39 μ; breadth 14–22 μ; breadth of apex 7–11 μ; breadth of isthmus 6·5–11 μ; thickness 9–17 μ.

England.—Helln Pot near Selside, Moughton Fell, Penyghent, S. of Cray Moss, and Cowgill Wold Moss, W. Yorks! Mickle Fell and Mossdale Moor, Widdale Fell, N. Yorks! Chippenham Fen, Cambridgeshire! Enbridge Lake, Hants (*Roy*).

Scotland.—Inverness, Aberdeen, Kincardine, Forfar, Perth, Stirling (*Roy & Bissett*).

Ireland.—Cloonee Lough, Kerry! Dublin and Wicklow (*Archer*). Slieve Donard, Down!

Geogr. Distribution.—Germany. Galicia and Bohemia in Austria. Italy. Sweden. Greenland. Spitzbergen. Nova Zembla. Java (form). United States.

This minute species is principally subalpine in habitat, being frequently found among mosses on wet limestone rocks, and its occurrence in the fen district of Cambridgeshire is certainly remarkable.

We have explained at length the reasons for regarding *Cosmarium angustatum* (Wittr.) Nordst. as synonymous with *Euastrum Pokornyanum* Grun. in the 'Journal of Botany,' 1900, p. 292–293, and in the 'Alga-fl. Yorks.' 1900, p. 79.

C. Pokornyanum should be compared with *C. trilobulatum*, from which it is distinguished by its retuse lobes and by the tumid vertical view.

42. **Cosmarium pseudatlanthoideum** West.

(Pl. LXIII, figs. 16, 17.)

Cosmarium pseudatlanthoideum West, Alg. Eng. Lake Distr. 1892, p. 725, t. 9, f. 21; Schmidle, in Hedwigia, 1895, p. 84.

Cells very small, about $1\frac{1}{2}$ times longer than broad, deeply constricted, sinus very narrow, slightly open outwards; semicells subtriangular from a broad base, basal angles broadly rounded, lower half of sides convex, upper half concave, apex narrow and rounded. Side view of semicell elliptic-ovate. Vertical view

narrowly elliptic, ratio of axes about 1 : 1·8. Cell-wall smooth.

Zygospore unknown.

Length 19·5 μ; breadth 13·5 μ; breadth of isthmus 4 μ; thickness 6·5 μ.

England.—Loughrigg, Westmoreland!

Geogr. Distribution.—United States (Colorado).

This small species is principally distinguished from *C. atlanthoideum* Delp. in being relatively narrower, and in the narrowly-elliptic vertical view without any trace of a median inflation.

43. **Cosmarium subtumidum** Nordst.

(Pl. LXIII, figs. 18–20.)

Cosmarium subtumidum Nordst. in Wittr. & Nordst. Alg. Exsic. 1878, no. 172; 1889, fasc. 21, p. 44 cum fig. xylogr.; Hansg. Prodr. Algenfl. Böhm. 1888, p. 249; Boldt, Desmid. Grönland, 1888, p. 16; De Toni, Syll. Alg. 1889, p. 950; West, Alg. N. Wales, 1890, p. 288; Alg. Eng. Lake Distr. 1892, p. 725; Roy & Biss. Scott. Desm. 1894, p. 175; Nordst. Index Desm. 1896, p. 248; West & G. S. West, Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 69; Alg. N. Ireland, 1902, p. 33. *Ursinella subtumida* Kuntze, Revis. gen. plant. 1891, p. 925.

Cells small, about $1\frac{1}{7}$ times as long as broad, deeply constricted, sinus very narrow with a dilated apex; semicells pyramidate-semicircular, basal angles rounded, lateral margins convex, apex widely truncate and generally straight. Side view of semicell circular. Vertical view elliptic, sometimes with the rounded poles very slightly produced, ratio of axes 1 : 1·84. Cell-wall minutely punctate. Chloroplasts axile, with one pyrenoid.

Zygospore globose and spiny, spines obtuse.

Length 30–40 μ; breadth 26–33 μ; breadth of isthmus 8–10·5 μ; thickness 17–19 μ; diam. zygosp. without spines 30–32 μ, with spines 44–51 μ; length of spines 6–12 μ; thickness of spines 3–5 μ.

England.—Westmoreland! W. and N. Yorks! Surrey! Kent! Cornwall!

Wales.—Llyn Pencraig near Bettws-y-coed, Llyn Bodgynwydd, Moel Siabod, Llyn Bochlwyd, Llyn-y-

cwm-ffynon, Glyder Fach (at 2,200 ft.), and Bethesda, Carnarvonshire!

Scotland.—Loch Inver, Sutherland; Poolewe and Falls of Connon, Ross; Brin, Inverness (*Roy & Bissett*). Rhiconich, Sutherland! Craig-an-Lochan and near Spittal of Glen Shee, Perth! Mull in Argyll (*Borye*). New Galloway, Kirkcudbright! Hoy, Orkneys!

Ireland.—Donegal! Galway! Mayo! Dublin and Wicklow (*Archer*). Down! Antrim! Lough Neagh!

Geogr. Distribution.—Germany. Austria. Portugal. Sweden. N. Russia. Greenland. Faeroes. Burmah (var.). Central China (var.). Australia. Central Africa. West Indies. Brazil.

C. subtumidum differs from *C. tumidum* in the pyramidate form of the semicells and the truncate apices, in the much narrower vertical view, and in the structure of the chloroplasts. It differs from *C. nitidulum* in the form of its semicells, which are less trapeziform with more convex sides. It is not an uncommon species in the more upland, boggy districts of the British Islands, and may sometimes be obtained in quantity.

Var **Klebsii** (Gutw.) West & G. S. West. (Pl. LXIII, figs. 21–23.)

Cosmarium Klebsii Gutw. Flor. glonów Galic. 1892, p. 127, t. 3, f. 3; West & G. S. West, Alg. S. England, 1897, p. 485; G. S. West, Alga-fl. Cambr. 1899, p. 115; West and G. S. West, Alga-fl. Yorks. 1900, p. 74; Alg. N. Ireland, 1902, p. 33; Further Contrib. Freshw. Plankton Scott. Lochs, 1905, p. 484.

Basal angles of semicells more widely rounded, and the sides more convergent, making a narrower truncate apex.

Length 32–41 μ; breadth 29–35 μ; breadth of isthmus 7–11 μ; thickness 16–18 μ.

England.—Pilmoor, N. Yorks! Near Ely and Wicken Fen, Cambridgeshire! New Forest, Hants!

Wales.—Llyn-y-cwm-ffynon, Carnarvonshire!

Scotland.—Not uncommon in the plankton of Inverness, and of Lewis and Harris, Outer Hebrides!

Ireland.—Near Glenties, and Loughs Akibbon, Gartan, Magrath, and Nacurg, Donegal! Lough Fea

and plankton of Lough Beg, Londonderry! Plankton of Lough Neagh and of Upper River Bann! Lough Derryadd, Armagh!

Geogr. Distribution.—Germany. Galicia in Austria.

This variety differs so little from the type that it is scarcely possible to distinguish between them. It also closely resembles in outline *C. Phaseolus* Bréb. var. *elevatum* Nordst., but the vertical view does not possess the median protuberances.

44. **Cosmarium galeritum** Nordst.

(Pl. LXIII, figs. 24, 25.)

Cosmarium galeritum Nordst. Desm. Brasil. 1870, p. 209, t. 3, f. 26; Wolle, Desm. U. S. 1884, p. 70, t. 16, f. 46, 48; Cooke, Brit. Desm. 1886, p. 87, t. 42, f. 14 [figures bad]; De Toni, Syll. Alg. 1889, p. 976; West, Alg. N. Yorks. 1889, p. 292; Alg. N. Wales, 1890, p. 288; Add. Alg. W. Yorks. II, 1891, p. 245; Alg. W. Ireland, 1892, p. 145; Roy & Biss. Scott. Desm. 1894, p. 101; Nordst. Index Desm. 1896, p. 128; West & G. S. West, Alga-fl. Yorks. 1900, p. 74; Alg. N. Ireland, 1902, p. 32.

Ursinella galerita Kuntze, Revis. gen. plant. 1891, p. 924.

Cells of moderate size, about $1\frac{1}{5}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity, slightly widening outwards; semicells pyramidate-trapeziform or truncate-pyramidate, basal angles well rounded, sides almost straight or slightly convex, upper angles rounded, apex narrowly truncate and generally slightly convex. Side view of semicell subcircular. Vertical view elliptic, ratio of axes about 1 : 1·9. Cell-wall punctate. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 51–56·5 μ; breadth 42–46 μ; breadth of isthmus 15·5–17 μ; thickness 23–24 μ.

England. — Helvellyn, Westmoreland! Malham Tarn, Penyghent, Cocket Moss near Giggleswick, and Roundhay Park near Leeds, W. Yorks! Pilmoor near Thirsk, Mickle Fell, and Great Shunnor Fell, N. Yorks! Riccall Common, E. Yorks! Enbridge Lake, Hants (*Roy*). Cornwall (*Marquand*).

Wales.—Llyn Coron, Anglesey!

Scotland.—Near Loch Inver, Sutherland; near Loch Coruisk in Skye, Inverness; Ben-na-chie, Morven, Birse, and Aboyne, Aberdeen; Perth!; near Corrie, Arran (*Roy & Bissett*). Near Lerwick, Shetlands!

Ireland.—Lough Anna and Sproule's Lough, Donegal! Ballynahinch, and Loughs Creggan, Derryclare, Letereen, and Shannacloontippen, Galway! Adrigole, Kerry! Lough Derryadd, Armagh!

Geogr. Distribution.—Germany. Galicia in Austria. Norway. Japan (var.). W. Africa. United States. Brazil. Argentina.

C. galeritum somewhat resembles *C. Lundellii* var. *ellipticum*, but the semicells are more pyramidate, the poles of the vertical view are not so pointed, and in size it is a little smaller. It is a *Cosmarium* which in the British Islands is constantly associated with *C. tetragonum*, *C. speciosum*, *C. notabile*, *C. ochthodes*, and other upland species.

45. **Cosmarium pseudonitidulum** Nordst.

(Pl. LXIII, fig. 26.)

Cosmarium pseudonitidulum Nordst. Norges Desm. 1873, p. 16, t. 1, f. 4; Wolle, Desm. U.S. 1884, p. 62, t. 18, f. 19; Cooke, Brit. Desm. 1886, p. 87, t. 42, f. 15 [figures bad]; De Toni, Syll. Alg. 1889, p. 973; West, Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 145; Roy & Biss. Scott. Desm. 1894, p. 172; Nordst. Index Desm. 1896, p. 209; West & G. S. West, Alga-fl. Yorks. 1900, p. 78.
Ursinella pseudonitidula Kuntze, Revis. gen. plant. 1891, p. 925.

Cells of moderate size, truncate-elliptic, about $1\frac{1}{4}$ times longer than broad, deeply constricted, sinus narrowly linear with a dilated extremity; semicells subtrapezoid or truncate-pyramidate, basal angles rounded, sides convex, at first suberect and then gradually converging, upper angles rounded, apex broadly truncate and very slightly convex. Side view of semicell ovate-circular. Vertical view elliptic, ratio of axes about 1 : 1·6. Cell-wall punctate. Chloroplasts axile, each with two pyrenoids.

Zygospore unknown.

Length 42 μ; breadth 33 μ; breadth of isthmus 10 μ; thickness 17–18 μ.

England.—Bowness, Westmoreland! Cullingworth, W. Yorks! Mickle Fell, N. Yorks!

Wales.—Bettws-y-coed!, Capel Curig! (*Cooke & Wills*), Snowdon (*Roy*), and Yr Orsedd!, Carnarvonshire.

Scotland.—Orkneys!, Sutherland, Ross, Inverness, Aberdeen, Kincardine, Forfar, Perth, Argyll, Arran (*Roy & Bissett*).

Ireland.—Adrigole, Kerry!

Geogr. Distribution.—Norway. Poland. Siam. Central China. United States.

This species stands very near to *C. nitidulum* De Not., but differs in the form of the semicells, which are wider at the apex, and in the presence of two pyrenoids in each chloroplast. From *C. galeritum* Nordst. it is distinguished by its smaller size and by its less pyramidate semicells with broader apices.

Var. **validum** *nob.* (Pl. LXIII, figs. 27–30.)

C. pachydermum Lund. var. *minus* Nordst. Norges. Desm. 1873, p. 18, t. 1, f. 7; De Toni, Syll. Alg. 1889, p. 970; Roy & Biss. Scott. Desm. 1894, p. 170; West & G. S. West, Desm. Singapore, 1897, p. 164; Freshw. Alg. Ceylon, 1902, p. 162.

Cells larger than in the type, with the basal angles sometimes more rectangular (not so rounded); cell-wall very firm and punctate.

Length 56–78 μ; breadth 46–59 μ; breadth of isthmus 17–25 μ; thickness 28–33 μ.

England.—Near Bowness, Westmoreland (*Bissett*). Cautley Spout, W. Yorks!

Wales.—Capel Curig, Carnarvonshire!

Scotland.—Poolewe, Ross; near Brin, Inverness; Glen Callater, Aberdeen; Canlochan, Forfar; Rannock, Perth; Alva Glen, Stirling (*Roy & Bissett*).

Geogr. Distribution.—Norway. India. Ceylon. Singapore. Azores. W. Africa.

This variety only differs from typical *C. pseudonitidulum* in its larger size and sometimes in its more rectangular basal

angles. The latter may even be slightly produced as in fig. 28, Pl. LXIII. Although originally described as a variety of *C. pachydermum*, we do not think it has any close affinity with that species, the outward form of the semicells being so very different.

46. **Cosmarium nitidulum** De Not.

(Pl. LXIV, figs. 1–3.)

Cosmarium nitidulum De Not. Desm. Ital. 1867, p. 42, t. 3, f. 26; Rabenh. Flor. Europ. Algar. III, 1868, p. 169; Lund. Desm. Suec. 1871, p. 35; Wolle, Desm. U.S. 1884, p. 62, t. 18, f. 18, t. 52, f. 9–10; Hansg. Prodr. Algenfl. Böhm. 1888, p. 194; Nordst. Freshw. Alg. N. Zeal. 1888, p. 59, t. 6, f. 17; De Toni, Syll. Alg. 1889, p. 935; West, Alg. N. Wales, 1890, p. 288; Alg. W. Ireland, 1892, p. 145; Alg. Eng. Lake Distr. 1892, p. 725; Roy & Biss. Scott. Desm. 1894, p. 169; Nordst. Index Desm. 1896, p. 181; West & G. S. West, Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 78.

Euastrum (*Cosmarium*) *nitidulum* Gay forma *genuina* Gay, Monogr. loc. Conj. 1884, p. 59.

Cosmarium nitidulum De Not. f. *punctulata* Gutw. Flor. glon. Galic. 2, 1890, p. 14, t. 1, f. 11.

Ursinella nitidula Kuntze, Revis. gen. plant. 1891, p. 925.

? *Cosmarium rectosporum* Turn. Freshw. Alg. E. India, 1893, p. 69, t. 10, f. 16.

Cells of moderate size, a little longer than broad, deeply constricted, sinus very narrowly linear with a slightly-dilated extremity; semicells truncate-subsemicircular, basal angles broadly rounded, sides convex and converging upwards, upper angles slightly rounded, apex small, truncate-convex, straight, or slightly retuse. Side view of semicell subcircular. Vertical view elliptic. Cell-wall very minutely punctate (punctulations often scarcely visible). Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 30–41 μ; breadth 23–33 μ; breadth of isthmus 8–10 μ; thickness 16–22·5 μ.

England.—Cullingworth, W. Yorks! Mickle Fell, Pilmoor, and near Bees Cliff, N. Yorks! Leicestershire (*Roy*). Thursley Common, Surrey!

Wales.—Capel Curig (*Cooke & Wills*) and Bethesda!, Carnarvonshire.

Scotland.—Heughhead near Aboyne, and foot of

Culblean, Aberdeen; N.W. side of Kerloch, Kincardine (*Roy & Bissett*). Meal Odhar, Perth!

Ireland.—Lough Derryclare, Kylemore, and lakes between Clifden and Roundstone, Galway! Lough Guitane and Sugar Loaf Mt., Kerry!

Geogr. Distribution.—France. Germany. Austria and Galicia. Italy. Sweden. Finland. N. Russia. Central China. Japan. New Zealand. Australia. United States. W. Indies. Brazil.

There is very little distinction between *C. nitidulum* and *C. pseudonitidulum* except for the difference in the pyrenoids. The semicells of *C. nitidulum* are generally more angular with a narrower apex and straighter sides.

C. nitidulum and *C. subtumidum* are also very closely related, but the semicells of the latter are much more rounded, with broader basal angles, more convex sides, and a less angular apex.

47. **Cosmarium canaliculatum** West & G. S. West. (Pl. LXIV, fig. 4.)

Cosmarium canaliculatum West & G. S. West, New and Int. Freshw. Alg. 1896, p. 154, t. 4, f. 57; Alg. S. England, 1897, p. 485.

Cells of medium size, about $1\frac{1}{3}$ times longer than broad, deeply constricted, sinus narrowly linear with a slightly-dilated extremity; semicells truncate-pyramidate, basal angles well rounded, sides almost straight or slightly convex, upper angles rounded, apex truncate and slightly convex. Side view of semicell shortly ovate towards the base with a slight swelling on each side. Vertical view elliptic, with a wide protuberance at the middle on each side. Cell-wall very thick, densely and irregularly scrobiculate, causing the exterior to appear slightly rough.

Zygospore unknown.

Length 72 μ; breadth 51 μ; breadth of isthmus 17·5 μ; thickness 35 μ.

England.—Near Goring, S.E. Oxfordshire!

This species is rather smaller than the average examples of *Cosmarium pyramidatum* Bréb., from which it is distinguished by the form of the front view, by its central protuberance, its

thicker cell-wall, and its more pronounced scrobiculations. Owing to the thickness of the cell-wall the latter have the appearance of short canals, and their large size and the comparative closeness of their disposition give the exterior of the cell-wall a slightly rough appearance.

48. **Cosmarium pyramidatum** Bréb.

(Pl. LXIV, figs. 5–7.)

Cosmarium pyramidatum Bréb. in Ralfs' Brit. Desm. 1848, p. 94, t. 15, f. 4 *a–c*; Arch. in Pritch. Infus. 1861, p. 731, t. 3, f. 14, 15 (in part); Rabenh. Flor. Europ. Alg. III, 1868, p. 162; Lund. Desm. Suec. 1871, p. 41; Delp. Desm. Subalp. 1877, p. 33, t. 9, f. 30–33; Kirchn. Alg. Schles. 1878, p. 149; Wolle, Desm. U. S. 1884, p. 69, t. 14, f. 16; Cooke, Brit. Desm. 1886, p. 86, t. 36, f. 13; Hansg. Prodr. Algenfl. Böhm. 1888, p. 197; De Toni, Syll. Alg. 1889, p. 969; West, Alg. N. Yorks, 1889, p. 292; Alg. N. Wales, 1890, p. 288; Heimerl, Desm. alp. 1891, p. 596; West, Alg. W. Ireland, 1892, p. 144; Alg. Eng. Lake District, 1892, p. 724; Roy & Biss. Scott. Desm. 1894, p. 173; Nordst. Index Desm. 1896, p. 215; West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 115; Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 78; Alg. N. Ireland, 1902, p. 33.

Didymidium (*Cosmarium*) *pyramidatum* Reinsch, Algenfl. Frank, 1867, p. 107.

Cosmarium pyramidatum b. *typicum* Klebs, Desm. Ostpreuss. 1879, p. 31, t. 3, f. 18, 19, 31.

Ursinella pyramidata Kuntze, Revis. gen. plant. 1891, p. 925.

Cells large, about $1\frac{1}{2}$ times as long as broad, truncate-elliptic in outline, deeply constricted, sinus very narrow and dilated towards the apex; semicells truncate-pyramidate, basal angles well rounded, sides convex and in the upper part converging, upper angles obtuse, apex narrowly truncate. Side view of semicell elliptic oblong. Vertical view elliptic, ratio of axes about 1 : 1·7. Cell-wall minutely scrobiculate. Chloroplasts axile, each with two pyrenoids.

(Zygospore globose and tuberculated.)

Length 58–100 μ; breadth 45–62 μ; breadth of isthmus 17·5–20 μ; thickness 26·5–36 μ.

England.—Cumberland! Westmoreland! (*Ralfs*). W., N., and E. Yorks! Lancashire! (*Ralfs*). Cheshire (*Ralfs*). Warwick (*Wills*). Surrey! (*Ralfs*). Sussex (*Ralfs*). Kent (*Ralfs*). Hants! (*Bennett*). Devon! (*Bennett*). Cornwall! (*Ralfs*).

Wales. — General in Carnarvonshire! Dolgelly, Merioneth (*Ralfs*).

Scotland.—General! (*Roy & Bissett*). Common in the Outer Hebrides! Orkneys! Shetlands!

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Down!

Geogr. Distribution.—France. Germany. Austria and Galicia. Hungary. Italy. Norway. Sweden. Denmark. Bornholm. Finland. S. Russia. India. Ceylon. Burmah (form). W. Africa. Azores. United States. Brazil. Paraguay. Uruguay (form). Argentina. Patagonia (form).

C. pyramidatum is generally distributed in the peat-bogs and peaty pools of the British Islands. It is also abundant in the rocky pools and lakes of the western areas of Scotland and Ireland.

Ralfs states that he obtained the zygospores at Dolgelly in Wales, but they do not appear to have been observed since. It is quite possible that the zygospores Ralfs examined were those of *C. pseudopyramidatum*, as that species was included in his *C. pyramidatum*. Moreover, he describes them as "tuberculated," which is a conspicuous feature of the zygospores of *C. pseudopyramidatum*.

The largest form of the species (forma *tropica* West & G. S. West) is known from Angola, W. Africa. It reaches a length of 170 μ and a breadth of 90 μ, and the semicells are slightly inflated with less truncate apices.

Var. **angustatum** West & G. S. West. (Pl. LXIV, fig. 8.)

C. pyramidatum Bréb. var. *angustatum* West & G. S. West, New Brit. Freshw. Alg. 1894, p. 5, t. 1, f. 18.

Cells narrower than in the type, almost twice as long as broad; semicells more evidently pyramidate, with straighter sides, basal angles very little rounded and almost submamillate.

Length 90–92 μ; breadth 48–50 μ; breadth of isthmus 13·5–15 μ.

England.—Near Bowness, Westmoreland!

Ireland.—Castletown, Kerry!

49. **Cosmarium pseudopyramidatum** Lund.

(Pl. LXIV, figs. 9–12.)

Cosmarium pyramidatum Bréb. in Ralfs' Brit. Desm. 1848, p. 94, t. 15, f. 4 *d, e, f.*

C. pyramidatum Bréb. var. *minus* Reinsch in Rabenh. Alg. 1868, no. 1902, f. 6.

C. pseudopyramidatum Lund. Desm. Suec. 1871, p. 41, t. 2, f. 18; Nordst. Desm. Spetsb. 1872, p. 29; Wolle, Desm. U.S. 1884, p. 69, t. 15, f. 11–13, t. 16, f. 5, 6; Cooke, Brit. Desm. 1886, p. 86, t. 37, f. 2; Hansg. Prodr. Algenfl. Böhm. 1888, p. 198; De Toni, Syll. Alg. 1889, p. 946; West, Alg. N. Wales, 1889, p. 288; Heimerl, Desm. alp. 1891, p. 597; West, Alg. W. Ireland, 1892, p. 144; Alg. Eng. Lake Distr. 1892, p. 724; Roy & Biss. Scott. Desm. 1894, p. 172; West & G. S. West, Alg. Madag. 1895, p. 56; Some N. Amer. Desm. 1896, p. 246, t. 15, f. 2; Nordst. Index Desm. 1896, p. 210; West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 115; Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 78; Alg. N. Ireland, 1902, p. 33.

Euastrum (*Cosmarium*) *pseudopyramidatum* Gay, Monogr. loc. Conj. 1884, p. 60.

Ursinella pseudopyramidata Kuntze, Revis. gen. plant. 1891, p. 925.

Cells of moderate size, about $1\frac{3}{4}$ times as long as broad, deeply constricted, sinus narrowly linear; semicells truncate-pyramidate or truncate-semi-elliptical, basal angles rounded, sides convex and converging to apex which is narrowly truncate, upper angles obtuse. Side view of semicell broadly elliptic. Vertical view elliptic, ratio of axes about 1 : 1·8. Cell-wall distinctly punctate. Chloroplasts axile, each with one pyrenoid.

Zygospore globose or ellipsoid, furnished with scattered submamillate warts.

Length 43–50 μ; breadth 25–33 μ; breadth of isthmus 7–10·5 μ; thickness 17–19·5 μ; diam. zygosp. with warts 32–44 μ.

England.—Cumberland! Westmoreland! (*Bissett*). W., N., and E. Yorks! Warwick (*Wills*). Surrey! Hants! (*Bennett*). Devon! Cornwall! (*Marquand*).

Wales.—Near Bethesda!, Capel Curig! (*Cooke & Wills*), Glyder Fawr!, and Pen-y-gwryd (*Roy*), Carnarvonshire. Llyn Coron, Anglesey!

Scotland.—Sutherland!, Ross, Inverness!, Aberdeen, Kincardine, Forfar!, Perth!, Dumbarton, Argyll, Arran (*Roy & Bissett*). Stirling! Common in the Outer Hebrides!

Ireland.—Donegal! Mayo! Galway! Kerry! Dublin and Wicklow (*Archer*). Down!

Geogr. Distribution.—France. Germany. Austria and Galicia. Poland. Hungary. Italy. Norway. Sweden. Finland. N. and S. Russia. Siberia. Spitzbergen. Nova Zembla. Faeroes. Ceylon. Siam. New Zealand (var.). Australia. W., Central, and E. Africa. Madagascar. United States. W. Indies. Brazil. Paraguay. Uruguay.

C. pseudopyramidatum is not so abundant as *C. pyramidatum*, from which it is distinguished by its much smaller size and by the presence of only one pyrenoid in the chloroplast of each semicell.

Nordstedt's "forma *minor*" and "forma *major*," which he describes from Spitzbergen, we include within the general range of size for this species. Lundell also mentions a "forma *major*"; length 52–64 μ; breadth 32–40 μ; breadth of isthmus 11–15 μ. This he states to be identical with Ralfs' figs. 4 *d*, *e*, and *f* of *C. pyramidatum*. It is, however, difficult to fix an arbitrary range of size for a "forma *major*," and these dimensions should really be included with those given under the description of the species.

Var. **stenonotum** Nordst. (Pl. LXIV, fig. 13.)

C. pseudopyramidatum Lund. subsp. *stenonotum* Nordst. Desm. Ital. 1876, p. 32, t. 12, f. 8; De Toni, Syll. Alg. 1889, p. 946; Roy & Biss. Scott. Desm. 1894, p. 172.

C. pyramidatum Bréb. c. *stenonotum* Klebs, Desm. Ostpreuss. 1879, p. 31, t. 3, f. 28–30.

Cells much larger, upper part of semicells suddenly narrowed, lateral margins below the apex slightly retuse. With one pyrenoid in each chloroplast.

Length 78–80 μ; breadth 46–48 μ; breadth of isthmus 16–17 μ; thickness 28–30 μ.

Wales.—Capel Curig and Glyder Fawr, Carnarvonshire (*Roy*).

Scotland.—Poolewe, Ross; Aberdeen; Kincardine; Ben Laoigh, Argyll (*Roy & Bissett*).

Geogr. Distribution.—Norway. Sweden. Italy. Poland. N. Russia. Bornholm. Japan. Australia. W. Indies. Paraguay.

This variety differs from *C. pyramidatum* var. *angustatum* in the more rectangular basal angles of the semicells and the more protracted apices, as well as in the single pyrenoids.

A small form of it is known from Australia and the West Indies:—length 35–36·5 μ; breadth 22–24 μ; breadth of isthmus 6·5–12 μ; thickness 13·5–16 μ.

50. **Cosmarium variolatum** Lund.

(Pl. LXIV, figs. 14–16.)

Cosmarium variolatum Lund. Desm. Suec. 1871, p. 41, t. 2, f. 19; Wolle, Desm. U. S. 1884, p. 63, t. 16, f. 3, 4; Cooke, Brit. Desm. 1886, p. 84, t. 36, f. 10 [figure bad]; De Toni, Syll. Alg. 1889, p. 954; West, Alg. W. Ireland, 1892, p. 144; Alg. Eng. Lake Distr. 1892, p. 724; Roy & Biss. Scott. Desm. 1894, p. 177; Nordst. Index Desm. 1896, p. 267; West & G. S. West, Welw. Afric. Freshw. Alg. 1897, p. 115; Alg. S. England, 1897, p. 485; Alga-fl. Yorks. 1900, p. 78; Alg. N. Ireland, 1902, p. 33.

C. pseudopyramidatum Lund. var. *variolatum* Hansg. Prodr. Algenfl. Böhm. 1888, p. 198.

Ursinella variolata Kuntze, Revis. gen. plant. 1891, p. 926.

Cells small, about $1\frac{3}{5}$ times longer than broad, deeply constricted, sinus narrowly linear with a slightly-dilated apex; semicells semi-elliptic, basal angles very slightly rounded, sides convex and upwardly converging, apex very narrow, truncate, and often subretuse. Side view of semicell obovate-elliptic. Vertical view broadly elliptic, ratio of axes about 1 : 1·8. Cell-wall firm, densely scrobiculate, the scrobiculations being relatively large and very conspicuous. Chloroplasts axile, each with one pyrenoid.

Zygospore unknown.

Length 32–35 μ; breadth 18–21 μ; breadth of isthmus 5–6·5 μ; thickness 15–16·5 μ.

England.—Near Bowness, Westmoreland (*Bissett*). Baildon, W. Yorks! Thursley Common, Surrey! New Forest, Hants!

Wales.—Capel Curig, Carnarvonshire! (*Cooke & Wills*).

Scotland. — Ross, Aberdeen, Kincardine, Perth, Argyll, Arran (*Roy & Bissett*). Sutherland! Outer Hebrides! Orkneys!

Ireland.—E. of Glenties, Donegal! Ballynahinch,

Lough Athry, and lakes between Clifden and Roundstone, Galway! Adrigole, Kerry! Dublin and Wicklow (*Archer*).

Geogr. Distribution.—Germany. Galicia in Austria. Poland (var.). Norway. Sweden. Ceylon. New Zealand (var.). Australia (var.). W. Africa. United States. Brazil.

This characteristic little species is easily distinguished from *C. pseudopyramidatum* by its smaller size and its densely-scrobiculate cell-wall. It is a much rarer Desmid than either of the two preceding species.

EXPLANATIONS OF THE PLATES.

EXPLANATION OF THE LETTERING.

a, *a'*. Front view of cell or semicell.
b, *b'*. Vertical view.
c. Side view.
d. Basal view of semicell.

Plate 33

PLATE XXXIII.

FIGS.		PAGE
1–3.	—*Euastrum ventricosum* Lund. All × 430 .	4
4–6.	—*E. crassum* (Bréb.) Kütz. 4 and 6, × 430; 5, × 400. The upper semicell of fig. 6 shows a common variation in which there is a median rounded protuberance on the sides of the semicell	5
7–8.	—*E. crassum* var. *scrobiculatum* Lund. All × 430.	7

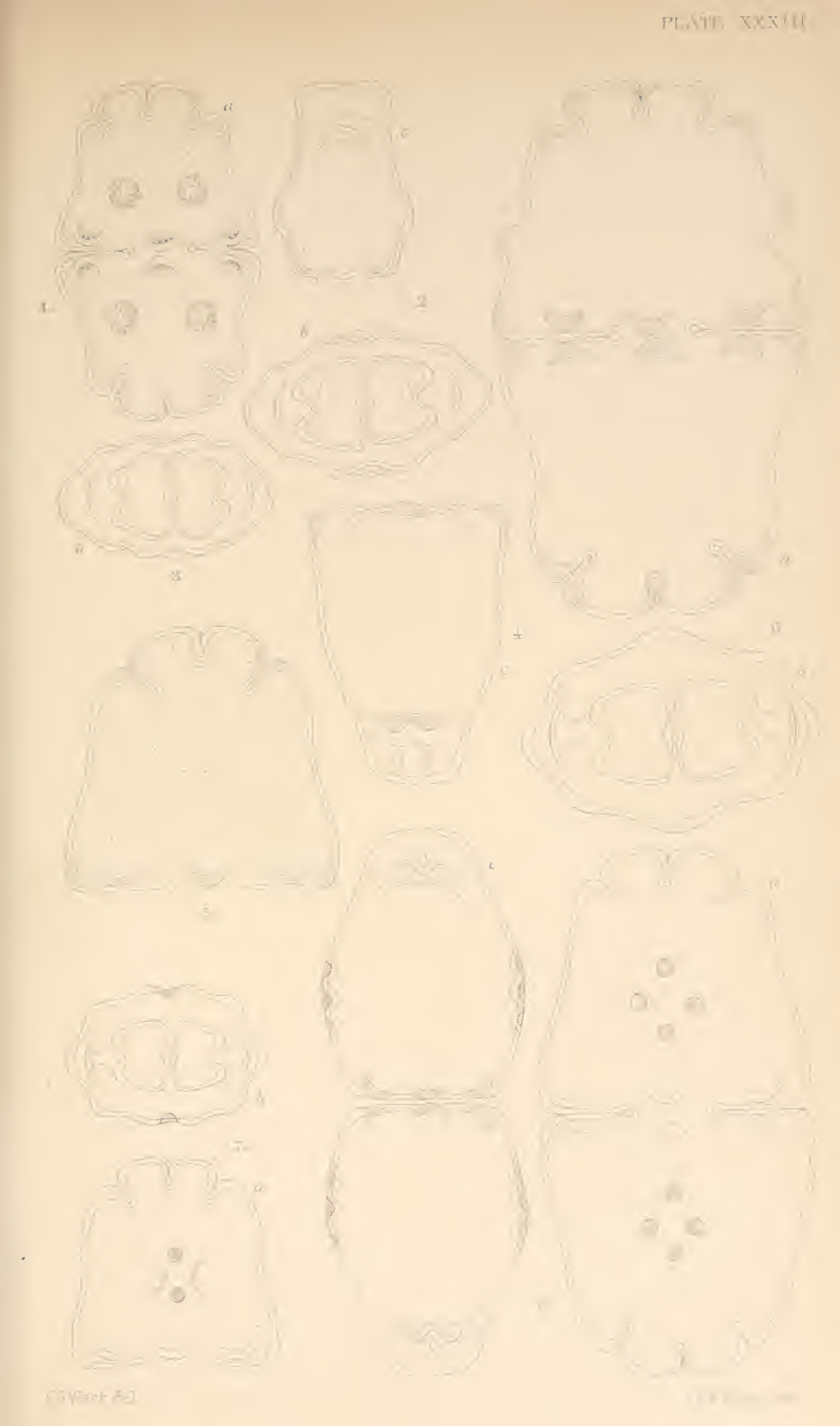


PLATE XXXIV.

FIGS. PAGE

1–2.—*Euastrum humerosum* Ralfs. 1, × 520; 2, × 400 (after Ralfs) 8

3–6.—*E. pinnatum* Ralfs. 3–5, × 430; 6, × 400 . 10

7–9.—*E. oblongum* (Grev.) Ralfs. All × 430. Fig. 8 is the side view and fig. 9 the vertical view taken from a smaller specimen than fig. 7 . 12

10.—*E. oblongum* var. *depauperatum* West & G. S. West. × 520 15

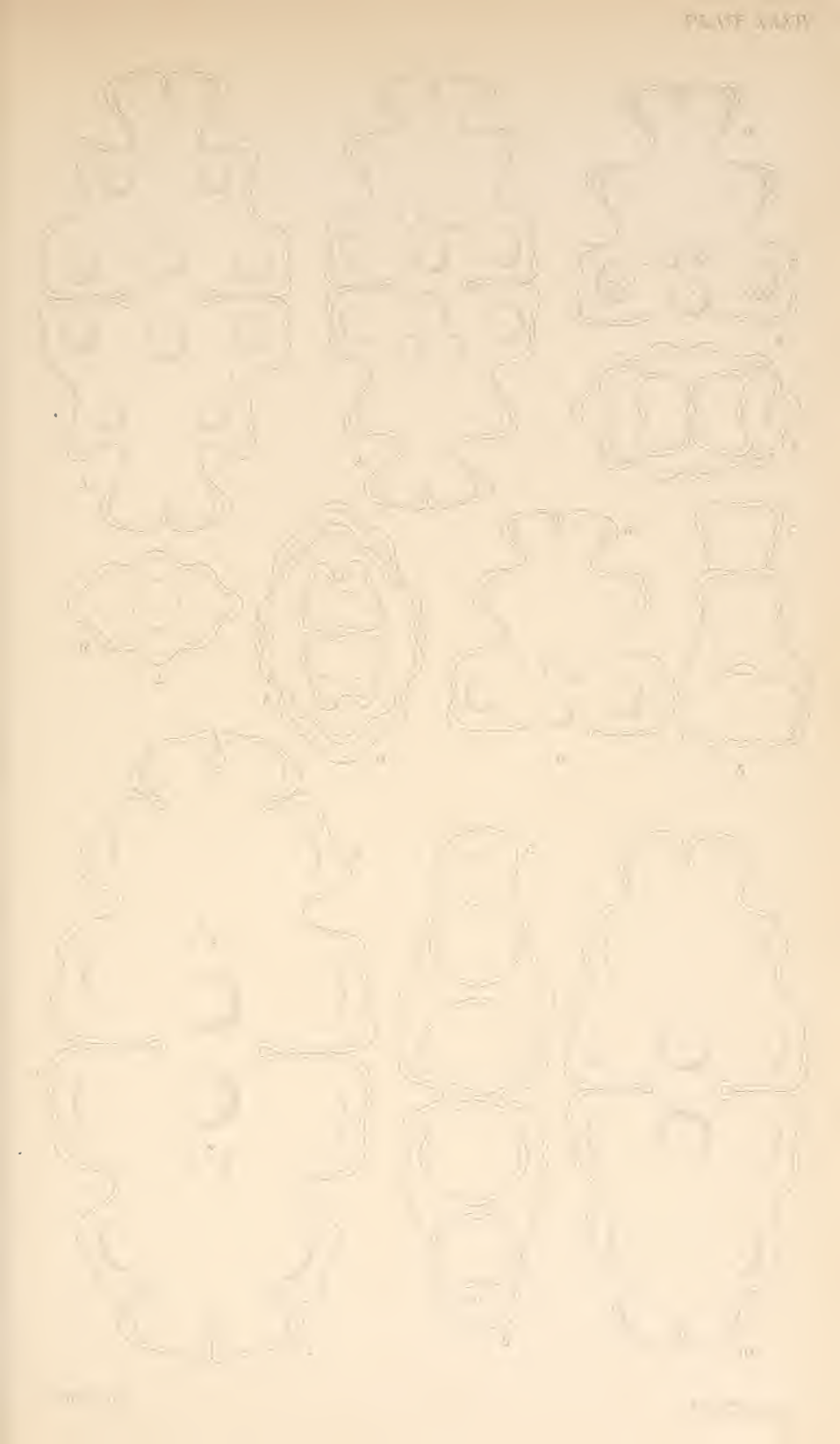


PLATE XXXV.

FIGS. PAGE

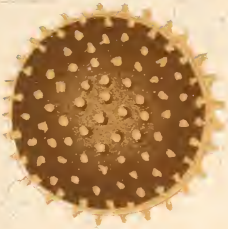
1.—*Euastrum oblongum* (Grev.) Ralfs var. *cephalophorum* West. × 400 . . . 14

2.—*E. oblongum*. Zygospore, × 220 . . 14

3–7.—*E. Didelta* (Turp.) Ralfs. 3, 5, and 6, × 430; 4, × 220; 7, zygospore, × 220 . . 15

8–10.—*E. ampullaceum* Ralfs. 8 and 9, × 520; 10, zygospore, × 390 . . . 19

11–12.—*E. affine* Ralfs. 11, × 400 (after Ralfs); 12, × 430 17



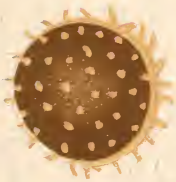


PLATE XXXVI.

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7–8.	—*E. inerme* (Ralfs) Lund. × 430	24
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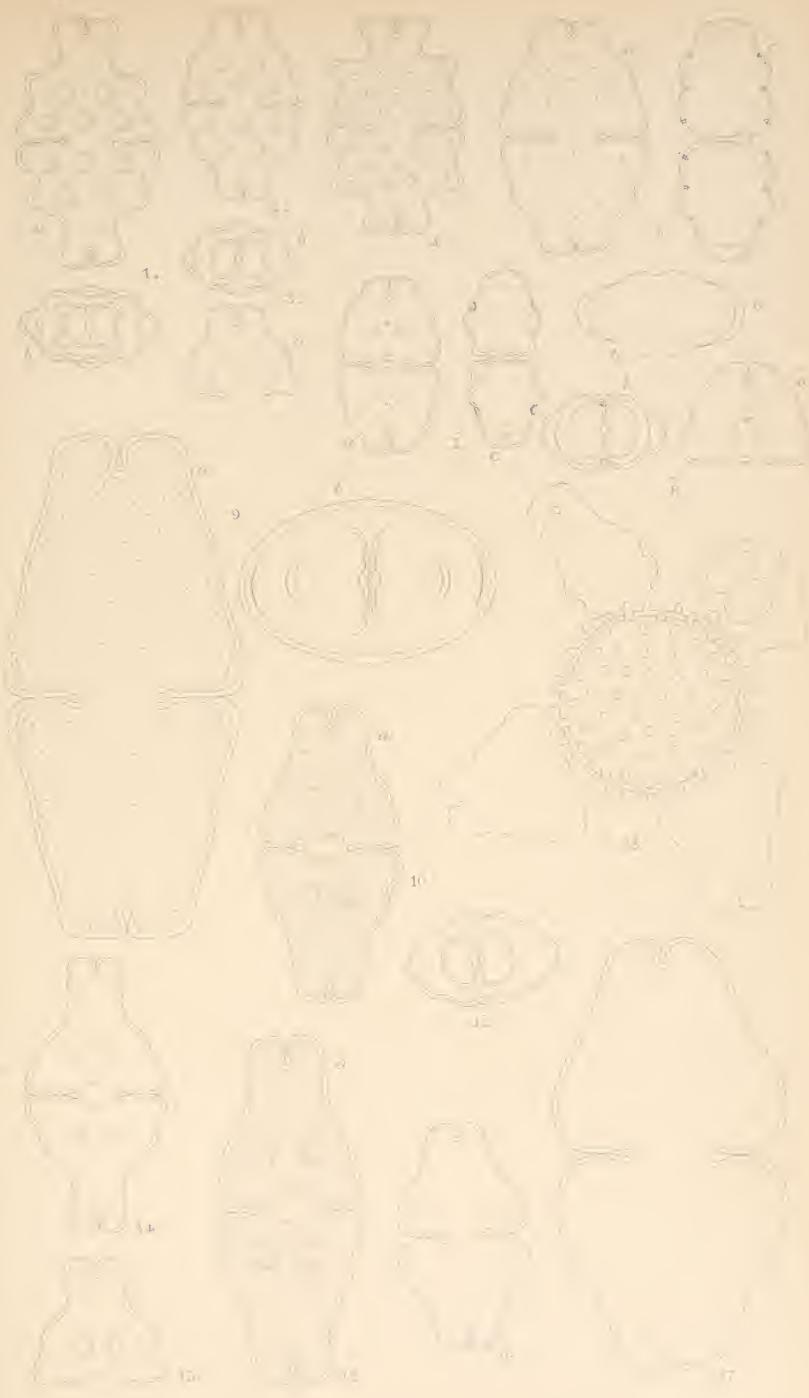

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PLATE XXXVII.

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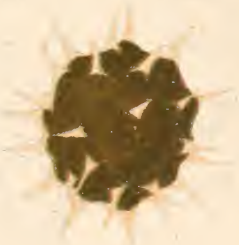

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PLATE XXXVIII.

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10.	—*E. dubium* var. *cambrense* (Turn.) West & G. S. West. × 500 (after Turner)	45
11.	—*E. dubium* var. *Snowdoniense* (Turn.) West & G. S. West. × 500 (after Turner)	45
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PLATE XXXIX.

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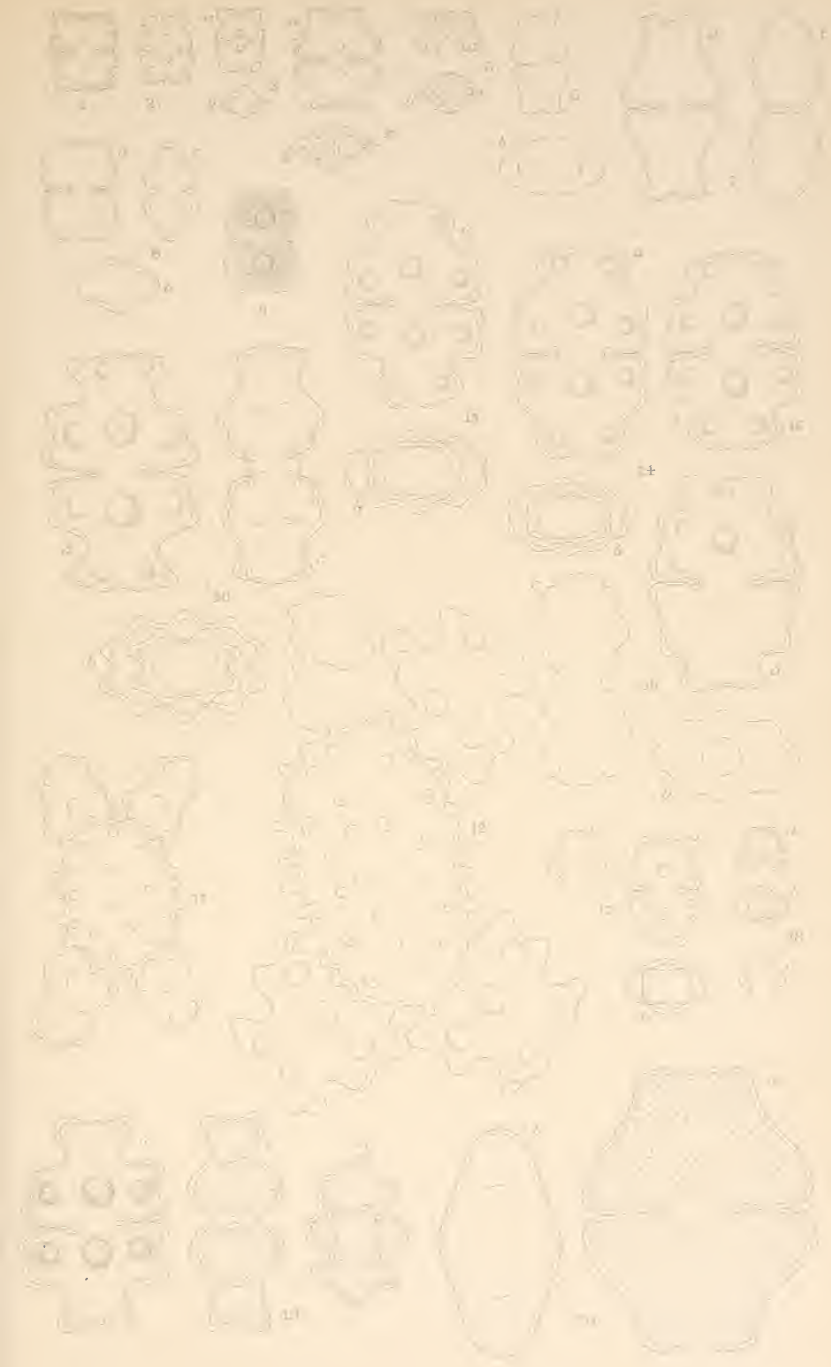

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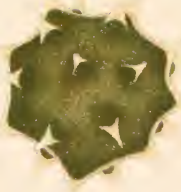

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FIGS. PAGE

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10–13.—*M. crenata* Bréb. 10 and 11, × 200 (after Ralfs); 12 and 13, × 520 . . 85

14.—*M. Jenneri* Ralfs. × 520 . . . 86

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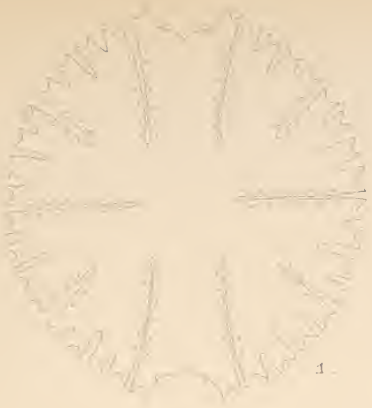
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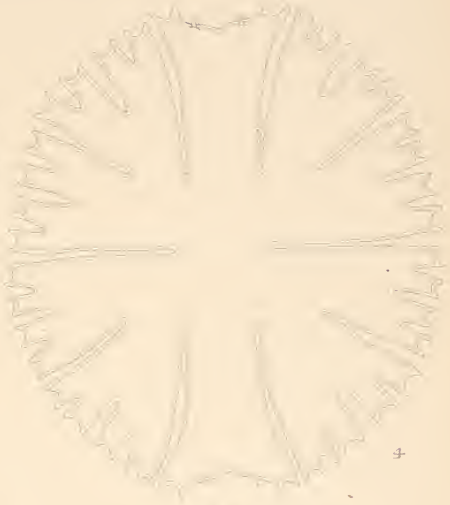
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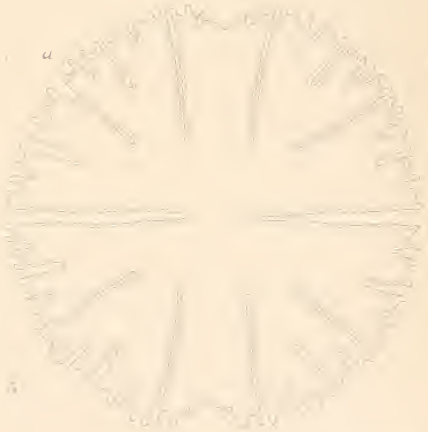
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PLATE XLV.

FIGS. PAGE

1–3.—*Micrasterias Murrayi* West & G. S. West. 1, × 300; 2 and 3, × 430 . . . 93

4.—*M. Murrayi* var. *triquetra* West & G. S. West. × 520 94

5–6.—*M. truncata* (Corda) Bréb. × 220 . . 82

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PLATE XLVI.

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PLATE XLVII.

FIGS. PAGE

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6.—*M. apiculata* var. *brachyptera* (Lund.) West & G. S. West. × 200 (after Lundell) . 101

7.—*M. apiculata* var. *brachyptera* (Lund.) West & G. S. West. A smooth form (forma *glabriuscula* Nordst.) × 200 (after Nordstedt) . 102

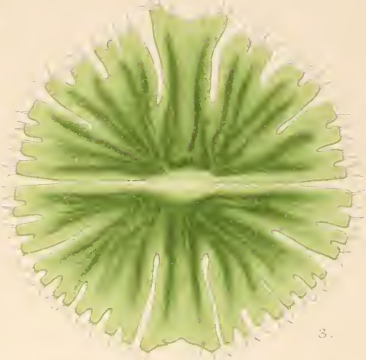

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PLATE XLVIII.

FIGS. PAGE

1–6.—*Micrasterias rotata* (Grev.) Ralfs. 1, × 500; 2 and 3, polar lobes of two individuals, × 220; 4, vertical view, × 200 (after Archer); 5, side view, × 200 (after Archer); 6, zygospore, × 400 (after Lundell) . . 102

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PLATE XLIX.

FIGS. PAGE

1–7.—*Micrasterias denticulata* Bréb. 1, × 400; 2 and 3, polar lobes of two individuals, × 220, 4, vertical view; 5, side view; 6, basal view of semicell; 4–6, × 200 (after Archer). 7, zygospore, × 400 (after Ralfs) . . 105

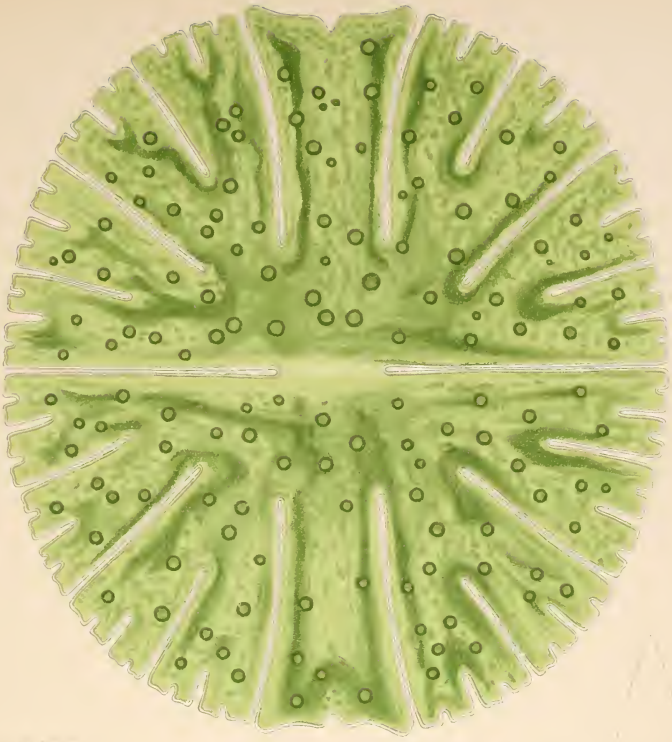

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PLATE L.

FIGS. PAGE

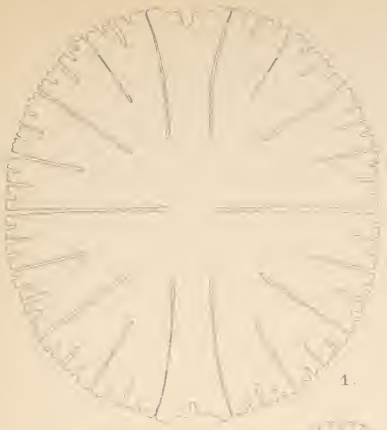
1–2.—*Micrasterias denticulata* Bréb. 1, × 200; 2, zygospore, × 120 . . . 105

3–4.—*M. denticulata* var. *angulosa* (Hantzsch) West & G. S. West. 3, × 200; 4, zygospore, × 200 (after Roy & Bissett) . . . 107

5.—*M. denticulata* var. *angustosinuata* Gay. Portion of semicell, × 400 . . . 108

6.—*M. denticulata* var. *notata* Nordst. 6*a*, × 300; 6*b*, × 180 108

7.—*M. denticulata* var. *subnotata* West. Vertical view, × 220 108



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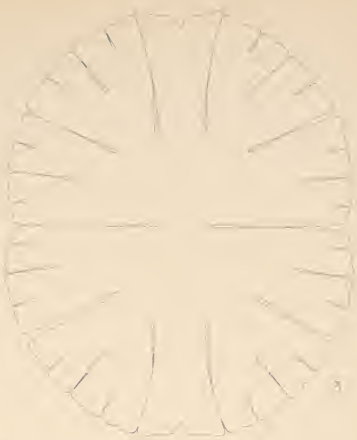

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PLATE LI.

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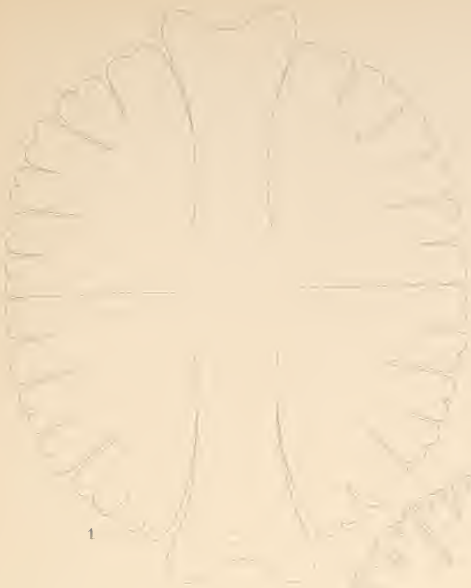
7.	—An intermediate form between *M. Thomasiana* and *M. denticulāta*. × 170 . .	112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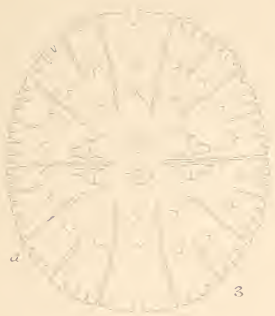
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PLATE LII.

FIGS. PAGE

1–9.—*Micrasterias radiata* Hass. 1, × 400; 2, × 520; 3, basal view of semicell, × 520; 4, × 200; 5, specimen showing reduction of divisions of lateral lobes, × 300; 6, × 200; 7, drawing of an American specimen which approaches *M. dichotoma* Wolle; 8 and 9, abnormal conditions of lateral lobules, × 400 . . 113

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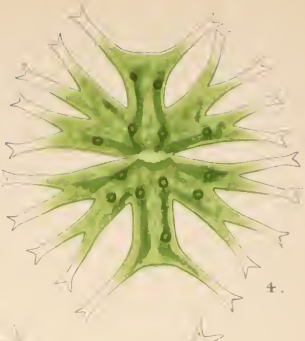

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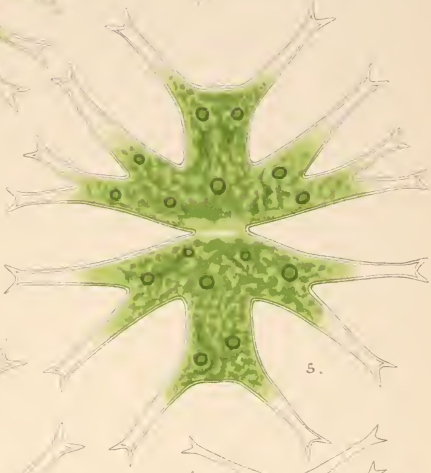

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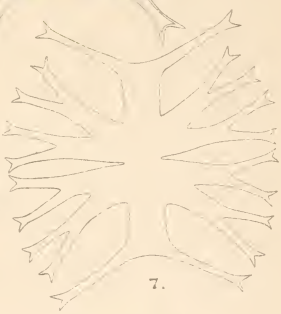

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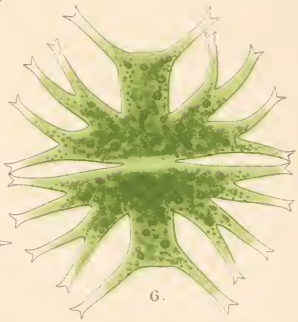

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PLATE LIII.

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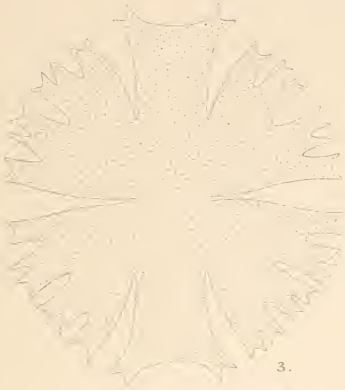

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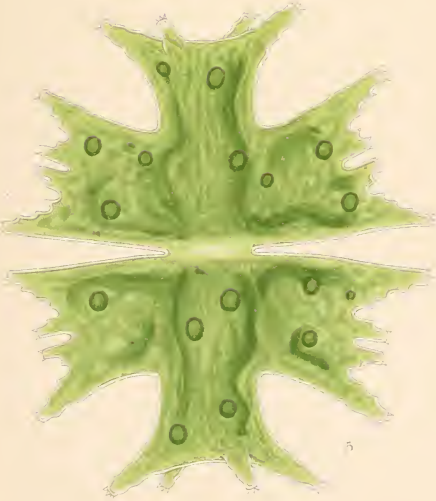

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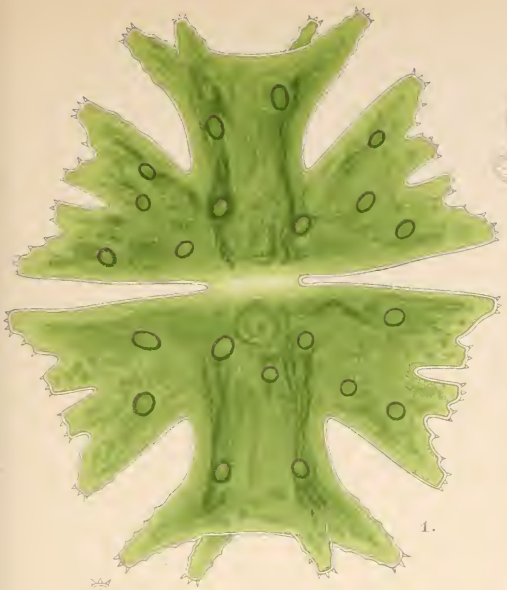

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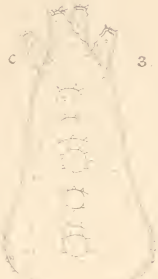

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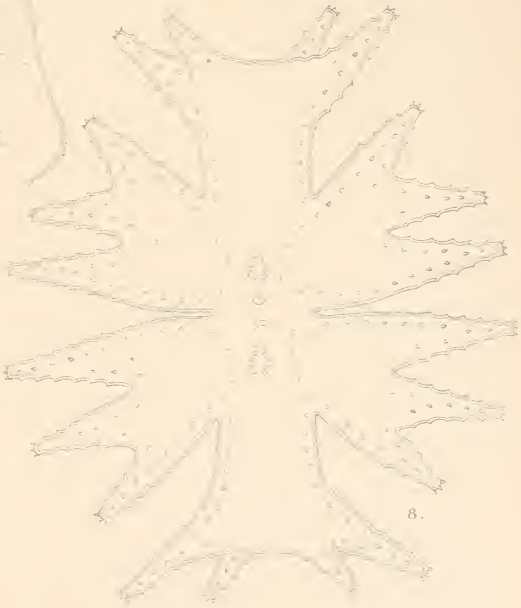

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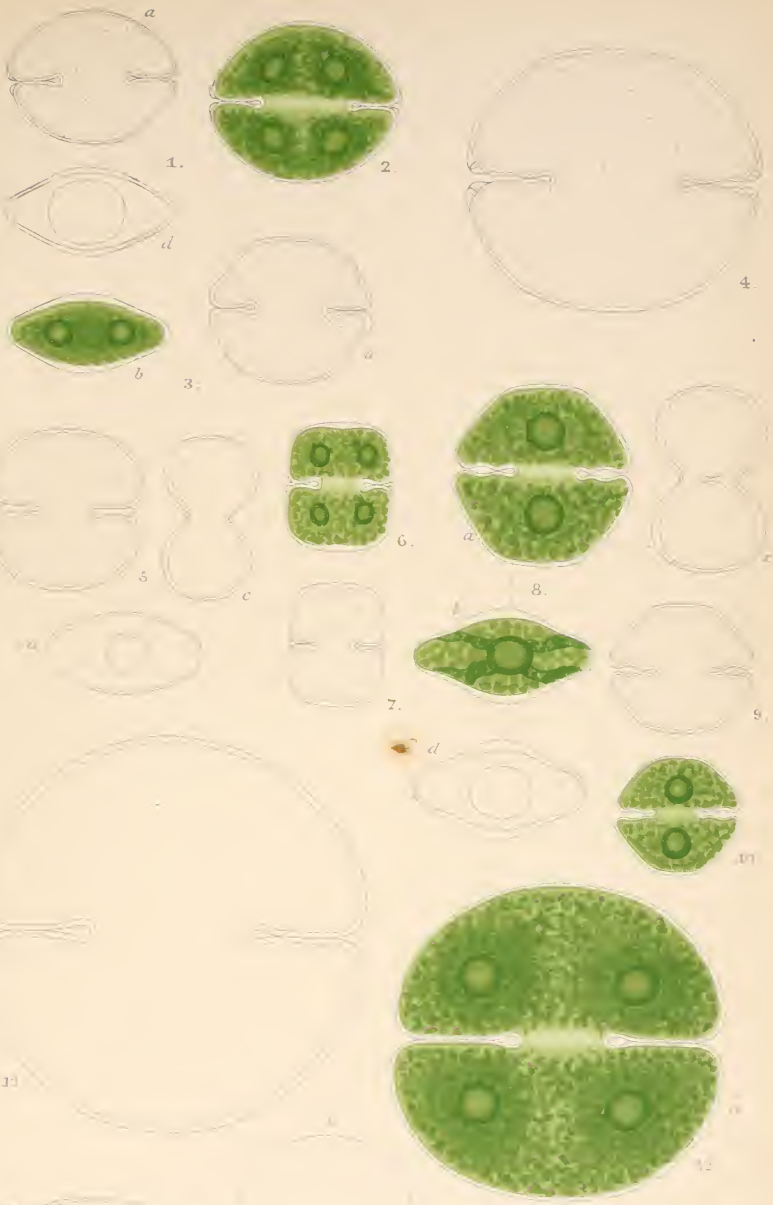
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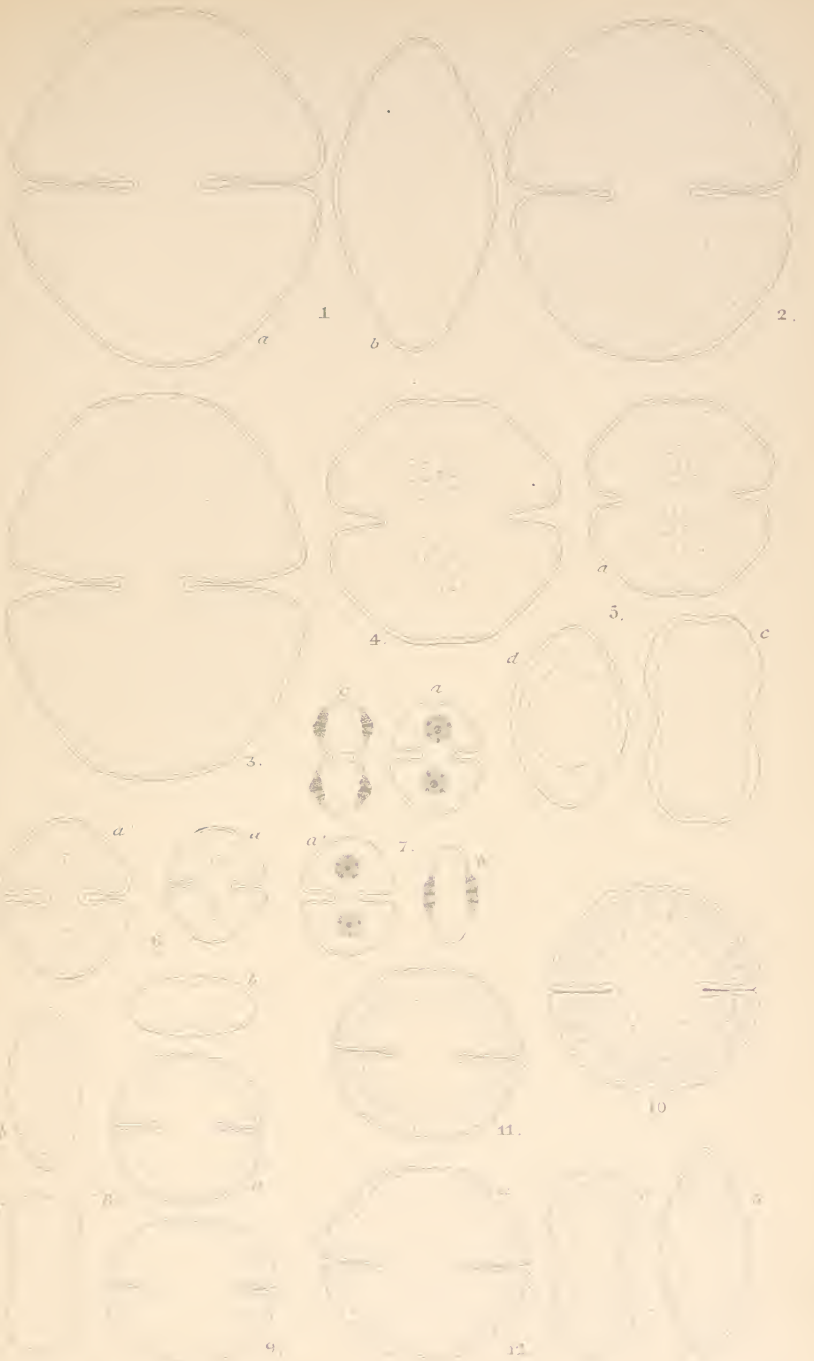
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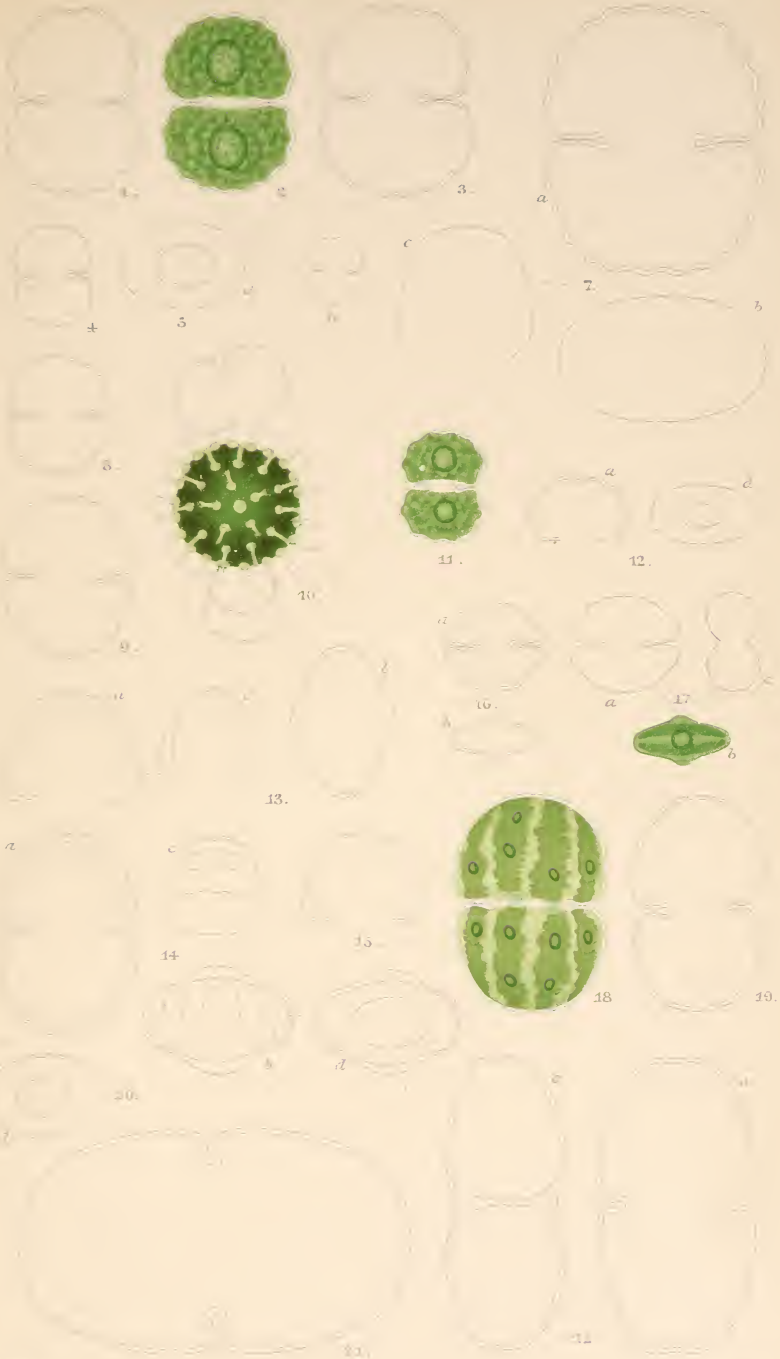
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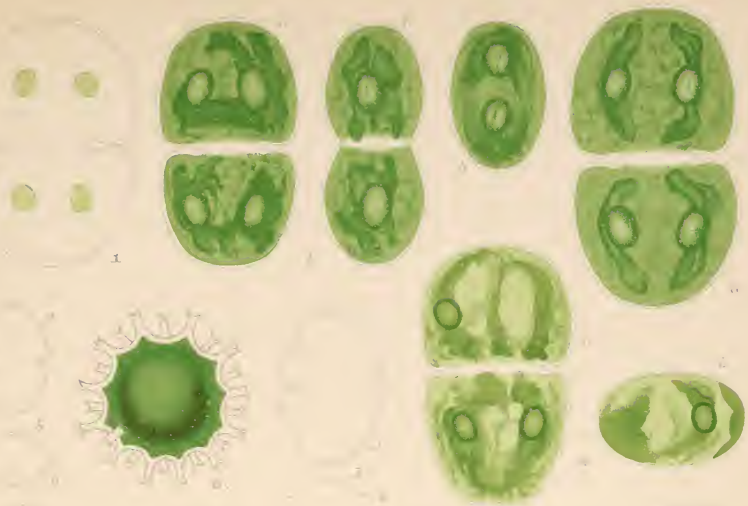

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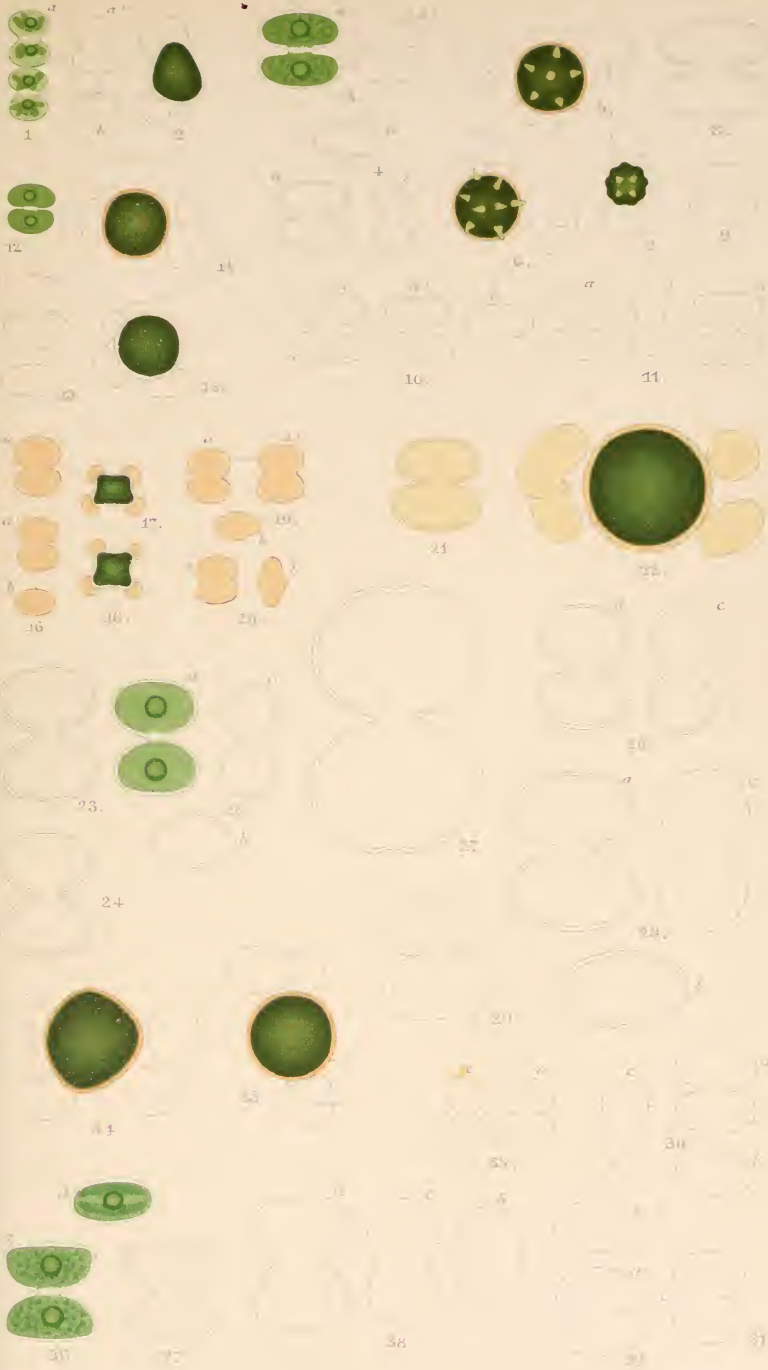

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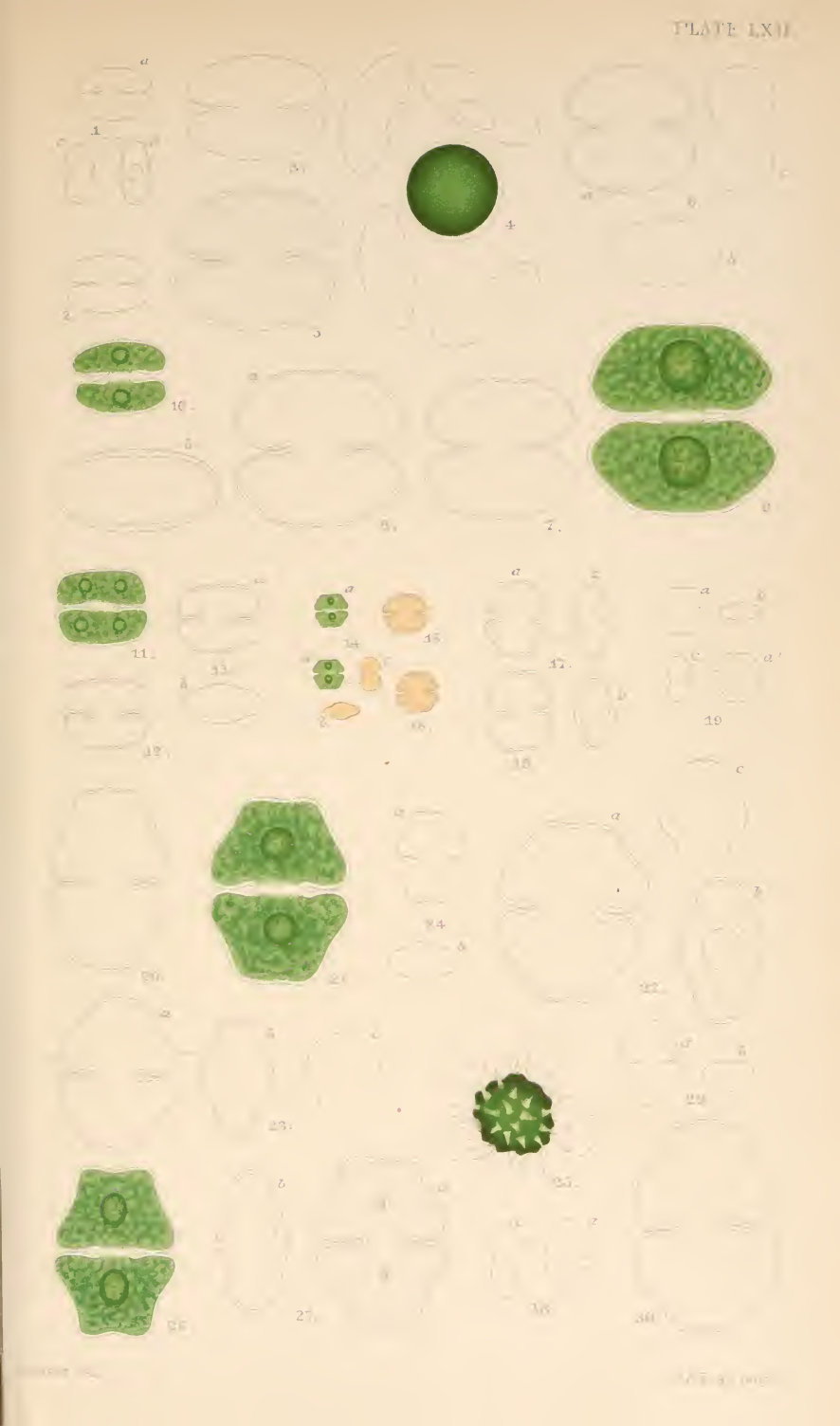

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LIST OF THE PUBLICATIONS

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RAY SOCIETY.

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1 Reports on the Progress of Zoology and Botany, 1841, 1842. viii + 496 + xx pp. 8vo. 1845.

The State of Zoology in Europe, as regards the Vertebrata. By C. L. Bonaparte. Transl. by H. E. Strickland. pp. 1-44.

The Progress of Zoology in 1842. Transl. from the German by W. B. Macdonald. pp. 1-348.

The Progress of Physiological Botany in 1841. By H. F. Link. Transl. by Edwin Lankester. pp. 1-104. Index, pp. i-xx.

2 A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part I. x + 20 pp., 10 plates. Folio. 1845.

3 Memorials of John Ray, consisting of his Life by Dr. Derham; . . . with his Itineraries, etc. Edited by Edwin Lankester. xii + 220 pp. 8vo. 1846.

For the Second Year, 1845.

4 On the Alternation of Generations. By J. J. S. Steenstrup. Transl. from the German version of C. H. Lorenzen by George Busk. viii + 132 pp., 3 plates. 8vo. 1845.

5 A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part II. iv + 34 pp., 13 plates. Folio. 1846.

6 Reports and Papers on Botany. viii + 494 pp., 7 plates. 8vo. 1846.

On the Morphology of the Coniferæ. By J. J. Zuccarini. Transl. by George Busk. pp. 1-54, 441-444, pls. i-v.

Report on Botanical Geography, 1842. By A. Grisebach. Transl. by W. B. Macdonald. pp. 55-212.

Memoir on the Nuclei, Formation, and Growth of Vegetable Cells. By Carl Nägeli. Transl. by Arthur Henfrey. pp. 213-292, 445-459, pls. vi, vii.

Report on Physiological Botany, 1842 and 1843. By H. F. Link. Transl. by J. Hudson. pp., 293-440. Index pp. 461-494.

For the third Year, 1846.

7 Outlines of the Geography of Plants. By F. J. F. Meyen. Transl. by Margaret Johnston. x + 422 pp., 1 plate. 8vo. 1846.

8 The Organization of Trilobites. By Hermann Burmeister. Edited by Thomas Bell and Edward Forbes. xii + 136 pp., 6 plates. Folio. 1846.

9 A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part III. iv + 30 pp., 12 plates. Folio. 1847.

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10 Elements of Physiophilosophy. By Lorenz Oken. From the German by Alfred Tulk. xx + 666 pp. 8vo. 1847.

11 Reports on Zoology for 1843, 1844. Transl. from the German by George Busk, Alfred Tulk, and A. H. Haliday. viii + 596 pp. 8vo. 1847.

Progress of Zoology in 1843. pp. 1–232.
" " 1844. pp. 233–564.
Index, pp. 565–596.

12 A Monograph of the British Naked-eyed Medusæ. By Edward Forbes. viii + 104 pp., 13 plates. Folio. 1848.

For the Fifth Year, 1848.

13 Bibliographia Zoologiæ et Geologiæ. A General Catalogue of all Books, Tracts, and Memoirs on Zoology and Geology. By Louis Agassiz. Edited by H. E. Strickland. Vol. I. Periodicals, and A–B. xxvi + 506 pp. 8vo. 1848.

14 The Correspondence of John Ray. Edited by Edwin Lankester. xvi + 502 pp., 2 plates. 8vo. 1848.

15 A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part IV. iv + 28 pp., 12 plates. Folio. 1848.

For the Sixth Year, 1849.

16 Reports and Papers on Botany. Edited by Arthur Henfrey. viii + 514 pp., 3 plates. 8vo. 1849.

On the Structure of the Palm-stem. By H. von Mohl. pp. 1–92, 495, pl. i.
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Report on Physiological Botany for 1844 and 1845. By H. T. Link. pp. 191–314.

Report on Geographical Botany for 1844. By A. Grisebach. pp. 315–414.
Report on Geographical and Systematic Botany for 1845. By A. Grisebach. pp. 415–494.

17 The Natural History of the British Entomostraca. By W. Baird. viii + 364 pp., 36 plates. 8vo. 1850.

For the Seventh Year, 1850.

18 Bibliographia Zoologiæ et Geologiæ. A General Catalogue of all Books, Tracts, and Memoirs on Zoology and Geology. By Louis Agassiz. Edited by H. E. Strickland. Vol. II. C–F. iv + 492 pp. 8vo. 1850.

19 A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part V. iv + 62 pp., 16 plates. Folio. 1851.

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24 Botanical and Physiological Memoirs. Edited by Arthur Henfrey. xvi + 568 pp., 6 plates. 8vo. 1853.
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25 A Monograph of the Sub-class Cirripedia. By Charles Darwin. The Balanidæ, the Verrucidæ, etc. viii + 684 pp. 8vo. 1854.

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27 A Monograph of the British Nudibranchiate Mollusca. By Joshua Alder and Albany Hancock. Part VII. vi + 54 + 40 + xlvi pp., 9 plates. Folio. 1855.

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39 The Miscellaneous Botanical Works of Robert Brown. [Edited by John J. Bennett.] Vol. I, containing I, Geographico-botanical, and II, Structural and Physiological Memoirs. viii + 612 pp. 8vo. 1866.

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For the Twenty-fifth Year, 1868.

44 Vegetable Teratology, an Account of the Principal Deviations from the Usual Structure of Plants. By Maxwell T. Masters. With Numerous Illustrations by E. M. Williams. xxxviii + 534 pages. 8vo. 1869.

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47 A Monograph of the Gymnoblastic or Tubularian Hydroids. By George James Allman. Conclusion of Part I, and Part II, containing descriptions of the Genera and Species of the Gymnoblastea. iv + 2 (xxiii, xxiv) + 296 (155–450) + 22 pp., 11 plates (xiii–xxiii). Folio. 1872.

For the Twenty-eighth Year, 1871.

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57 A Monograph of the British Spongiadæ. By the late J. S. Bowerbank. Vol. IV (Supplementary). Edited, with additions, by the Rev. A. M. Norman. xviii + 250 + 34 pp., 17 plates. 8vo. 1882.

For the Thirty-seventh Year, 1880.

58 A Monograph of the British Aphides. By George Bowdler Buckton. Vol. III. vi + 142 + 56 pp., 28 plates (lxxxvii–cxiv). 8vo. 1881.

For the Thirty-eighth Year, 1881.

59 A Monograph of the British Phytophagous Hymenoptera. By Peter Cameron. Vol. I. viii + 340 + 42 pp., 21 plates. 8vo. 1882.

For the Thirty-ninth Year, 1882.

60 A Monograph of the British Aphides. By George Bowdler Buckton. Vol. IV. x + 228 + 62 pp., 27 plates (D–I, cxv–cxxxiv, cxiv bis). 8vo. 1883.

For the Fortieth Year, 1883.

61 British Oribatidæ. By Albert D. Michael. Vol. I. xii + 336 + 62 pp., 31 plates (i–xxiv, A–G). 8vo. 1884.

For the Forty-first Year, 1884.

62 A Monograph of the British Phytophagous Hymenoptera. By Peter Cameron. Vol. II. vi + 234 + 54 pp., 27 plates. 8vo. 1885.

For the Forty-second Year, 1885.

63 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. I. (The Butterflies.) Edited by H. T. Stainton. xvi + 202 + 34 pp., 17 plates. 8vo. 1886.

For the Forty-third Year, 1886.

64 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. II. (The Sphinges or Hawk-moths and part of the Bombyces.) Edited by H. T. Stainton. xii + 172 + 36 pp., 18 plates (xviii–xxxv). 8vo. 1887.

For the Forty-fourth Year, 1887.

65 British Oribatidæ. By Albert D. Michael. Vol. II. xii + 322 (337–658) + 62 pp., 31 plates (xxv–liv, xlviia). 8vo. 1888.

For the Forty-fifth Year, 1888.

66 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. III. (The concluding portion of the Bombyces.) Edited by H. T. Stainton. xvi + 80 + 36 pp., 18 plates (xxxvi–liii). 8vo. 1889.

For the Forty-sixth Year, 1889.

67 A Monograph of the British Phytophagous Hymenoptera. By Peter Cameron. Vol. III. vi + 274 + 34 pp., 17 plates. 8vo. 1890.

For the Forty-seventh Year, 1890.

68 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. IV. (The first portion of the Noctuæ.) Edited by H. T. Stainton. xii + 116 + 32 pp., 16 plates (liv–lxix). 8vo. 1891.

For the Forty-eighth Year, 1891.

69 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. V. (The second portion of the Noctuæ.) Edited (in part) by the late H. T. Stainton. xii + 90 + 34 pp., 17 plates (lxx–lxxxvi). 8vo. 1893.

For the Forty-ninth Year, 1892.

70 A Monograph of the British Phytophagous Hymenoptera. By Peter Cameron. Vol. IV. vi + 248 + 38 pp., 19 plates. 8vo. 1893.

For the Fiftieth Year, 1893.

71 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. VI. (The third and concluding portion of the Noctuæ.) Edited by Geo. T. Porritt. xii + 142 + 38 pp., 19 plates (lxxxvii–cv). 8vo. 1895.

For the Fifty-first Year, 1894.

72 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. VII. (The first portion of the Geometræ.) Edited by Geo. T. Porritt. xvi + 176 + 44 pp., 22 plates (cvi–cxxvii). 8vo. 1897.

For the Fifty-second Year, 1895.

73 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. VIII. (The concluding portion of the Geometræ.) Edited by Geo. T. Porritt. xii + 120 + 70 pp., 20 plates (cxxviii–cxlvii). 8vo. 1899.

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For the Fifty-fourth Year, 1897.

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For the Fifty-sixth Year, 1899.

77 The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. IX. (The Deltoides, Pyrales, Crambites, Tertrices, Tineæ, and Pterophori.) Edited by Geo. T. Porritt. xviii + 420 + 34 pp., 17 plates (cxlviii–clxiv). 8vo. 1901.

For the Fifty-seventh Year, 1900.

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For the Sixty-first Year, 1904.

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For the Sixty-second Year, 1905.

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